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AVIATION

The Oldest American Aeronautical Magazine

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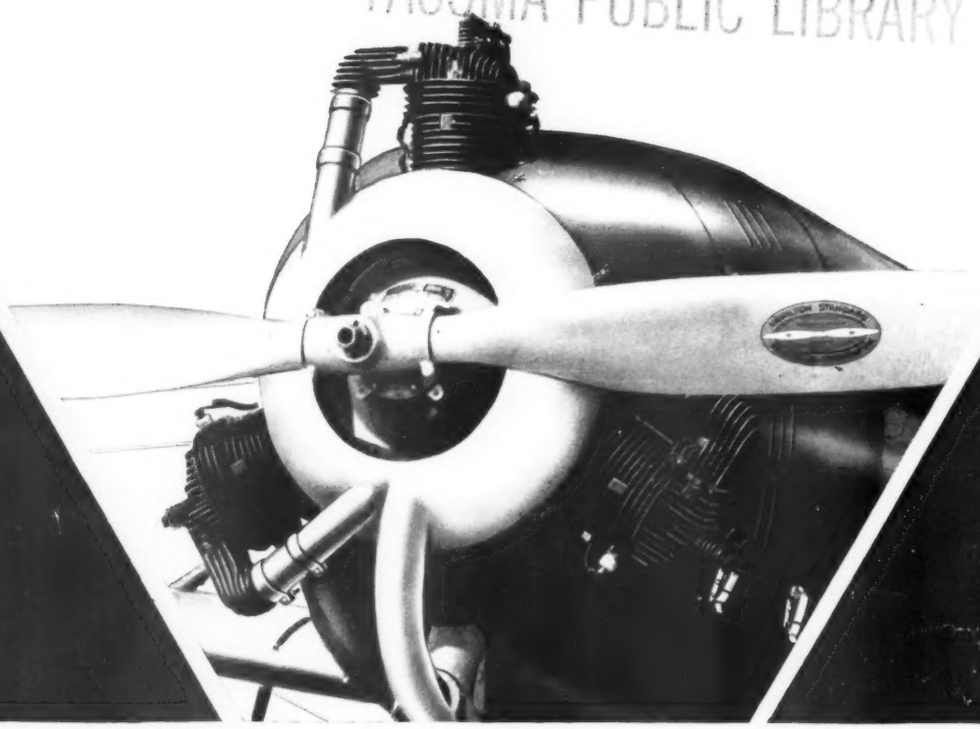

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AVIATION
A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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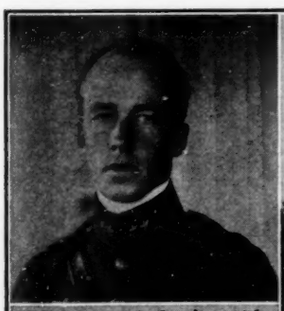
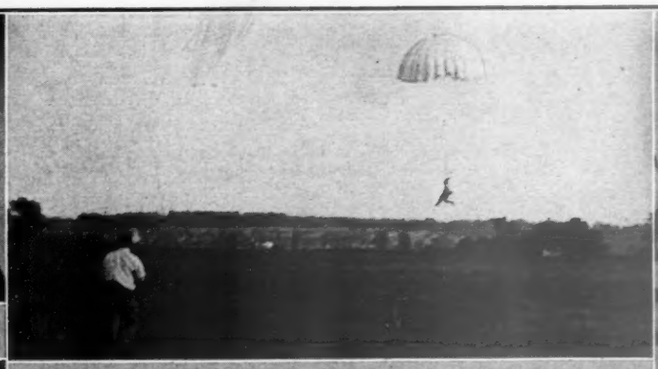


SAVED! In Sweden, 1926 Lt. Nils Soderberg, S.R.A.F.



SAVED! Major "Jimmie" Doolittle for the second time (here shown floating safely to earth) at E. St. Louis, Ill., June 23, 1931.

SAVED! Four different times, Col. Chas. A. Lindbergh

SAVED! Mildred Kaufman, at Buffalo, N.Y. '30

SAVED! In England, April, '27. Flight Lt. David Grieg British Royal Air Force

SAVED! In Siam, Lt. Nam Bhandh Nagrob.

SAVED! Miss Fay Gillis, Sept. 1, 1929.

SAVED! V. Pessarenko, U. S. S. R. (Russia) Aug. 20, 1928.

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SAVED! Lt. Amarilio Vierra Cortez, Brazilian Navy, May 21, 1930.

SAVED! S. J. Sampson, Air Mail Pilot, Mar. '29

SAVED! Ted Wells, civilian pilot, on Sept. 10, 1930 at Wichita, Kansas.

SAVED! Lieutenants of Air Corps Lowe, Holland, Bridget, Kuntz and McCormick of Brooks Field, Texas, all saved with IRVIN'S.

SAVED! Lt. Eugenjusz Sacrewski of Polish Air Service.

Neither Mysterious nor Miraculous

THE GROWING IMPORTANCE OF THE AUTOGIRO TO AVIATION, RESULTS FROM ITS PROVABLE CORRECTNESS

ANYONE with a sufficient knowledge of the theory of flight and a capacity for higher mathematics can understand and prove the correctness of the Autogiro principle.

For more than ten years, engineers have been concentrating upon the problem now successfully solved in the Autogiro. The problem itself was clear-cut—to develop a type of aircraft which would be free of the airplane's complete dependence upon high speed for take-off, support in the air, and landing—hence immune to serious consequences from motor failure or from loss of headway through whatever cause. Freedom from the airplane's requirements of huge, prepared landing fields would follow as an inevitable result.

The Autogiro's success is the result of well-known and long-established principles in a distinctly new method of application.

Both airplane and Autogiro are sustained in flight by forces resulting from the rapid movement of the lifting surfaces through the air (wings in the case of the airplane, rotor-blades in the case of the Autogiro). The one essential difference between them is this:

The airplane's wings are fixed. Their movement through the air is therefore solely dependent upon the forward speed of the entire craft. On the contrary, the movement of the Autogiro's blades is *independent* of the speed of the craft itself. The speed of the blades' rotation is practically constant, whether the Autogiro is travelling fast or slow, hovering or descending. It is not affected even by motor failure.

To this one all-important difference are traceable all the Autogiro's distinctive characteristics—its ability to stop in the air, hover momentarily, descend vertically and slowly, rise sharply; its immunity to spins or other critical situations; its ease of control and maneuverability.

The Autogiro Company of America is not a manufacturing or selling company. It is solely an engineering and licensing organization. It owns and controls, exclusively, all Autogiro patent rights in the United States. Manufacturing companies of high standing will be licensed to build Autogiros with the full co-operation of our engineering staff.

Present licensees are: Buhl Aircraft Company, Detroit, Mich.; Kellett Aircraft Corp., Philadelphia, Pa.; Pitcairn Aircraft, Inc., Willow Grove, Pa.

"For the Greatest Achievement in American Aviation"

(Extract from article in May, 1931, issue of The National Aeronautic Magazine)

"Aviation's dramatic march of progress from Orville Wright's first flight at Kitty Hawk to the commanding position it now holds in the affairs of the Nation was strikingly symbolized on April 22 when President Hoover in behalf of the National Aeronautic Association presented the Collier Trophy for 1930 to Harold F. Pitcairn and his associates, Geoffrey S. Childs, Edwin T. Asplundh, James G. Ray and Agnew E. Larsen.

"There was a note also of prophecy in the ceremony for the occasion included a flying demonstration that a few short years ago even the most fanciful would have held impossible.

"'For the greatest achievement in aviation in America the value of which has been demonstrated by actual use during the previous year,' reads the inscription on the famous trophy, the awarding of which has been for many years an annual function of the National Aeronautic Association. For 1930 the award was made for the development and demonstration of the autogiro, that remarkable new type aircraft considered by many the most revolutionary development in heavier-than-air craft since the first flight of the Wright brothers in 1903."

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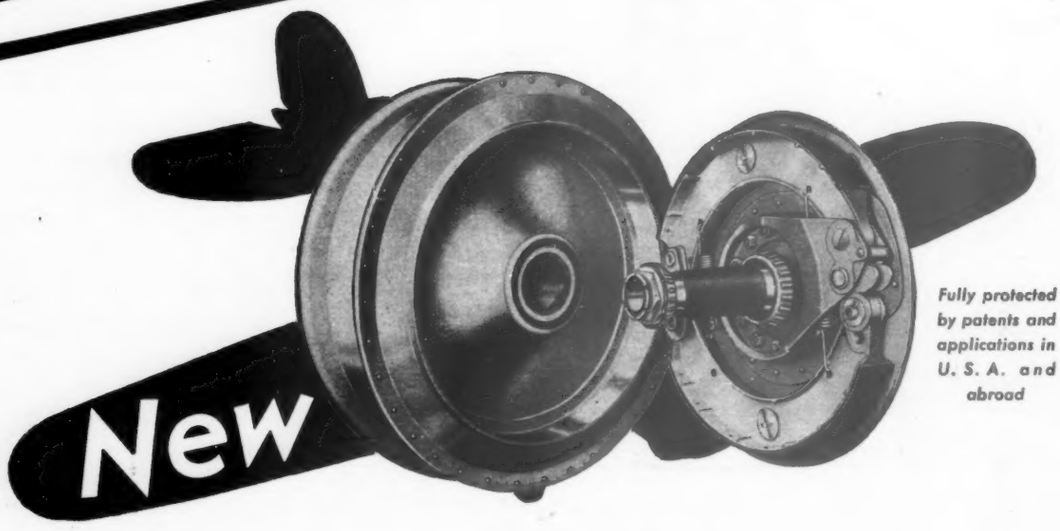

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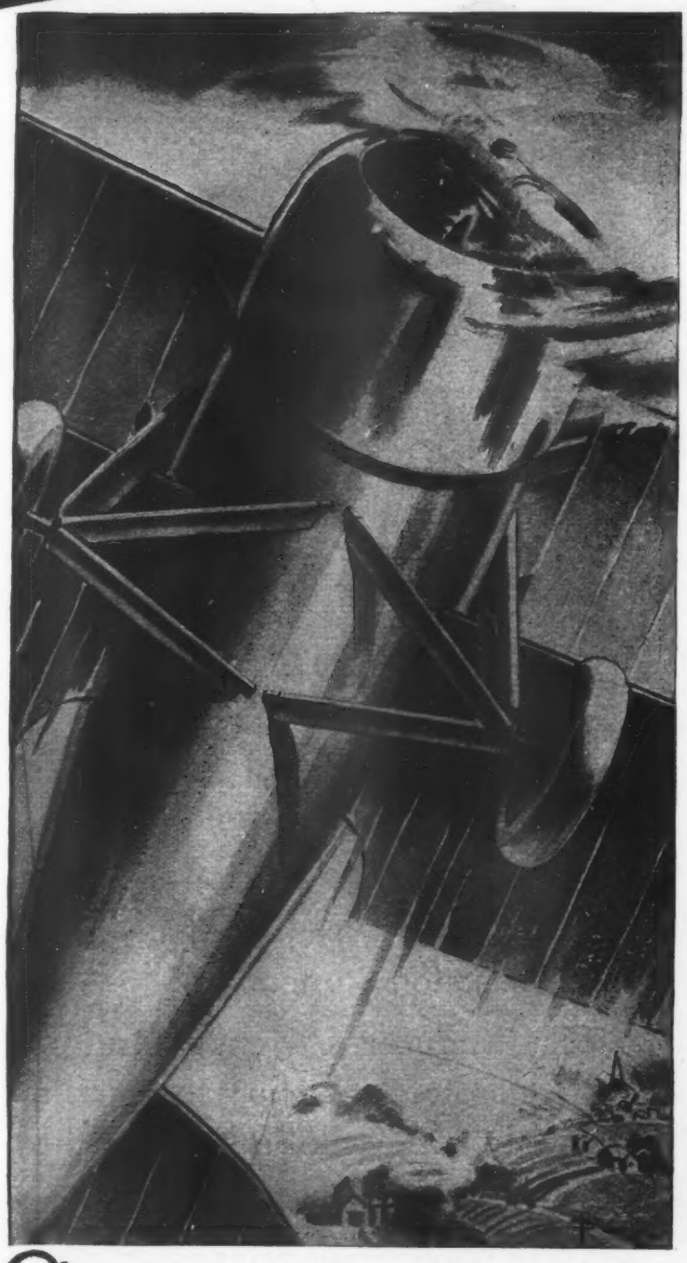

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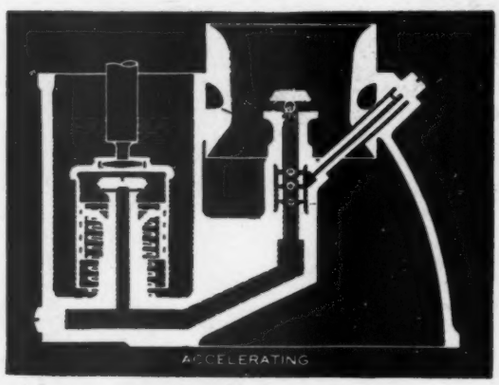
Stromberg Carburetors are used on over 95% of the aircraft engines now being built in the United States.



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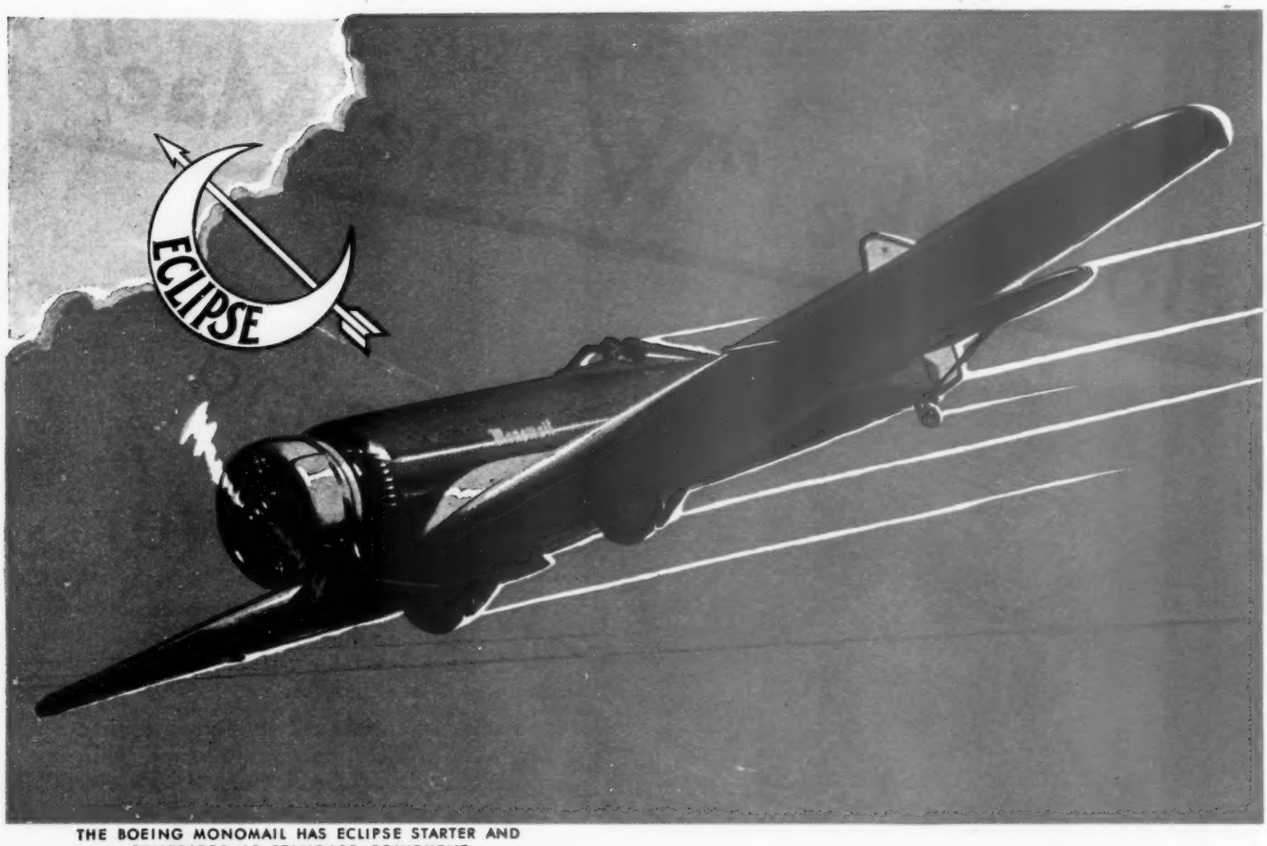

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NATIONAL AIR RACES

CLEVELAND—AUG. 29 - SEPT. 7

New, complete and well-appointed Air Race Administration Building and Grand Stand, recently constructed by The Austin Company.

SEE AVIATION ON REVIEW!

The rendezvous of an industry! How can you afford to miss this greatest of Aviation's Annual Events?

Here, at the National Air Races, Aviation's leaders will witness the newest developments and improvements in the industry, visualize Aviation's greatest accomplishments.

Cleveland welcomes you at this great sport event. Its complete and well appointed Air Race Administration Building and Grand Stand, its Executive Club and Social Club are ready to add to your comfort and enjoyment. These new structures, just completed by The Austin Company, will house elaborate facilities for participating pilots and Radio Room. The Tea Room, Cafeteria and Pilots' Grill have a Seating Capacity of over 2000.

Austin has designed and built 5 of the hangars at the Cleveland Airport.

You are especially invited to inspect this complete airport—see the many innovations in its great field, its service structures, its modern hangars as well as its new Air Race Administration Building and Grand Stand. A royal welcome awaits you!

Austin aeronautical projects will be found in 61 cities and 27 states from Coast to Coast. For many leading aviation corporations Austin has designed and built modern hangars, aircraft and accessory plants. Whatever type or size of project you may be considering, it will pay you to get in touch with Austin.

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1931 NATIONAL AIR RACES CLEVELAND

AVIATION
A McGRAW-HILL PUBLICATION . . . EST. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

VOLUME 30 . . . *August, 1931* . . . NUMBER 8

Fifteen years of AVIATION

FIFTEEN years is a very short time in most human affairs, but in aeronautical matters it is a long one. It is a long enough period to give historical perspective. It is long enough to have covered two or three generations of airplane design, within each of which machines have passed from the status of greatly admired mechanical marvels to that of museum exhibits. It contains the whole history of commercial flying. It is fifteen years this month since the first issue of AVIATION appeared.

They have been active and varied years. They have not been spent on the side-lines, delicately cheering the industry on, but down in the arena with it, sharing its trials and triumphs. AVIATION has been the industry's paper, for the discussion of its own affairs, not a vehicle for the circulation of propaganda or the persuasion of the outside world. There have been occasions of rare importance when we have addressed ourselves directly to Congress or to public opinion, but they have been the exception. In general, like other business and technical journals in other fields, we have had the function of speaking *to* the aeronautical community, not *for* it. To be of any use in such a rôle, candor is indispensable. For fifteen years, AVIATION has observed, reported, suggested, advised, and when there was occasion has criticised. The course chosen has not always been the one that would lead to the easiest popularity, but the aggregate of the magazine's activities has, we hope and confidently believe, been of lasting service.

It has been a fascinating undertaking to read back over the volumes of the past fifteen years in preparing to write this retrospect. On immediately succeeding pages we reproduce our records of a few of the great events of the period, but necessarily only a few. The earliest issues were full of names still very prominent in the aeronautical field. Among the contributors of feature articles to the first volume were Grover Loening, Donald W. Douglas, J. C. Hunsaker, now vice-president of Goodyear-Zeppelin, Ralph H. Upson, designer of the metal-clad airship, Capt. H. C. Richardson, now of Great Lakes, and Dr. C. Dornier. Prof. Alexander Klemin was technical editor. The present editor of AVIATION was a general technical assistant, and a contributor to the first and all of the immediately succeeding issues.

The first two and a half years were predominantly military. With the end of the war chaos threatened the industry, and Lester D. Gardner, the founder of AVIATION and for eleven years its publisher, set to work to promote sounder relations between the industry and the public and between the industry and the government. His efforts culminated in 1924, a year before the Morrow Aircraft Board was appointed, in the drafting and presentation for discussion of a national air policy.

The light plane and glider movements were being fostered by AVIATION, through a special department, eight years before light planes finally suddenly came onto the American market in bulk. The glider meets of 1922, the first year in which the soaring duration record exceeded an hour, were discussed and their significance interpreted by the present editor, the first representative of American aviation to visit the Wasserkuppe, and by Edmund T. Allen, the first American pilot to participate in post-war European gliding.

Although commercial operation and the commercial market have been of growing importance in the last few years, we have continued very much concerned with the work of the Army and Navy. The services and the industry have common interests of immense importance to both. AVIATION has worked for a com-

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August 1, 1917

$640,000,000 Appropriated for Army Aviation

On July 24 President Wilson signed the bill appropriating $640,000,000 for the enlargement of the Air Service of the Army. We give herewith two statements, one by Brig.-Gen. George O. Squier, Chief Signal Officer, and the other by Howard E. Coffin, chairman of the Aircraft Production Board, outlining as far as it is possible to do so, the plans of those charged with the expenditure of the appropriation:

Statement of Gen. Squier

"I am not here to make public our plans or to indulge in prophetic figures. The closest estimate I can give is about this: That the Allied Governments have determined to enter Germany by the air route and the United States Government is going to provide enough machines to make itself felt in putting this program through.

"That is not saying that we will construct 22,000 airplanes or 1,000,000 or ten or a dozen. If I knew how many machines we would or could construct in a year I wouldn't tell, because it would be ... [illegible]

Cost from $9,000 to $75,000

"People who are so exclusive about our determination to build 22,000 airplanes seem to be inspired with the notion that aeros are all made on the same pattern, turned out of the factory as alike as two cubes of sugar. As a matter of fact airplanes vary in cost between [illegible] and $75,000; and a comprehensive aerial program must include everything from a simple school machine to a flying dreadnaught. New inventions are continually being tried out, new appliances and models must be installed in order to keep up with the times—or a little ahead of them.

"The German General Staff—that mysterious body working and thinking out [illegible] time somewhere between Berlin and Stamboul—isn't going to [illegible] main at a standstill ov[illegible] may be called upon to [illegible] stem in order to [illegible] war, which, as [illegible] most elastic thi[illegible]

"A recent[illegible] German [illegible] that [illegible] oth[illegible] T[illegible]

a year would be required for the industrial preparation which this program demands. Yet we have no such length of time in which to perform the task now.

"In spite of our previous inexperience in quantity production of fighting planes we must have thousands of them for next year's use to make the contribution which the allies expect of us.

Must Await Results

"It must be remembered, therefore, that a few months will necessarily elapse before the output [illegible] of our industrial effort will [illegible] quantities of [illegible]

"It [illegible] most [illegible]

March 14, 1921

San Francisco to New York in 33 Hrs. 20 Min.

The United States Air Mail Service added another chapter to its long list of achievements when, in Feb. 23, Mail Pilot E. M. Allison delivered mail at Hazelhurst Field, Long Island, 33 hr. 20 min. after it had left Montgomery Field, San Francisco. The same type of airplane, a D.H.-4B, driven by seven pilots, made the entire trip of 2,650 miles.

The shortest previous time for delivering mail across the continent was seventy-two hours by a combination of airplane

Four Ships Start on Race

Four ships started on the test—two east bound, from San Francisco to New York, and two west bound, New York to San Francisco. One east bound flier—Capt. W. F. Lewis—was killed when his plane crashed to earth at Elko, Nev. The mail he carried was delivered, however. It was picked up at Elko by the other east bound flier and brought as extra weight.

The west bound planes were unfortunate in "bucking into" bad weather. One was forced to land at Dubois, Pa. Another reached Chicago, but because of storms the test flight was

Omaha and Chicago, and weather conditions were extremely trying.

This experiment in night flying was made to determine the practicability of continuous flying on the coast-to-coast route between New York and San Francisco, without a layover at night. The pilots undertaking the night flying volunteered for this service, no pilot being required to take the night flight under orders. In addition to the early darkness

800 Miles Flown by Night

One of the most important things this experiment demonstrated was the feasibility of night flying. This was mainly responsible for the great saving of time effected in carrying the mail from the Pacific to the Atlantic.

The section from Cheyenne to Chicago, a distance of 800 miles, was entirely flown between sunset and sunrise, with an intermediate landing at 1 a. m. at Omaha. The greater part of the night trip, from North Platte, Neb., to Chicago, was made by mail pilot, Jack Knight. His performance was the more remarkable as he had never before flown between

February 1, 1917

AERONAUTICS FOR 1917

ANY forecast of the developments likely to take place in the aeronautical industry this year is extremely dangerous because the possibilities of the industry are unlimited. Primarily, however, the development for 1917 is likely to be of a military character. The United States Army, at the present time, has under order 302 planes from twelve different companies and the purchase of 59 more machines has been authorized, but as yet the orders have not been placed. Only 73 machines are now in service with the Army, and the resources of the constructors will be strained to make prompt deliveries of the machines that have been ordered.

The appropriation, which appears to be likely to pass, for the fiscal year of 1918 carries $15,600,000 for further development of the military air service. This great sum will undoubtedly be increased by purchases of military and training airplanes by foreign governments. The Army lighter-than-air section is also being developed at Fort Omaha, Neb., and at Pensacola, Fla., the Navy is preparing to carry on extensive experiments with lighter-than-air craft both of the dirigible and non-dirigible types. So far as types of airplanes for the Army are concerned we are likely to witness the development of fast pursuit machines capable of speeds up to probably 150 miles an hour with a fuel capacity which will permit five-hour flights.

It is also probable that larger machines capable of carrying tremendous loads and equipped with two or more engines delivering in excess of 1000 horse-power will be flown in this country either this year or next year. Especially for the Navy will these great weight-carrying machines prove valuable. The Navy problem of developing a machine capable of operating in conjunction with the main fleet is only to be solved by the development of airplanes of enormous carrying capacity and great radius of action.

It is more than possible that the development of lighter-than-air craft of the Zeppelin type may solve this problem. More than $5,000,000 will probably be spent in Naval Aeronautics in the fiscal year.

Preliminary steps are likely to be taken, too, by the Post Office Department. The transportation of mail by air route is an inevitable eventual development, and even military men expect that in a few years the Post Office Department will be a larger purchaser of machines than the Army and Navy combined. This development is certain to lead to the commercial use of airplanes. Transportation through the air has certain obvious advantages in that the expense is limited to the upkeep of the machines themselves. There are no rights of way to be purchased, no expensive roadbeds to be built, no tunnels to be dug, no bridges to be constructed. The difficulty that stands in the way is said to be lack of reliability. The flying record of the Army air service from January 1st to December 26th, 1916, throws an interesting light on this supposed difficulty. The total amount of time in the air was 3,356 hours and 56 minutes, during which time 7,087 flights were made and the distance traveled was 251,775 miles. The fatalities were none.

Perhaps before airplanes realize their commercial possibilities they will be used for pleasure purposes. Just as the coming of the pleasure automobile preceded the coming of the truck, so it is likely to be with planes. So, before another year passes, we can probably look with fair certainty to the development of a modification of the Army and Navy's training biplanes, which will be built for sportsmen. Such machines, having high factors of safety, comparative simplicity of construction, light weight, and good climbing qualities should, if the prices are within reason, go far towards popularizing the sport of aviation.

W. D. MOFFAT, PRESIDENT
W. I. SEAMAN, TREASURER
H. I. BOWNE, GENERAL MANAGER

AVIATION AND AERONAUTICAL ENGINEERING

G. M. WILLIAMS, MANAGING EDITOR
LADISLAS WORCT, ASSOCIATE EDITOR
GEORGE NEWBOLD, BUSINESS MANAGER

Vol. V — September 1, 1918 — No. 3

Aircraft Production in the United States

Report of the Sub-Committee to the Senate Committee on Military Affairs

After having been engaged in another investigation of a phase of the aircraft situation since the first part of June, the report of the sub-Committee on Military Affairs, headed by Senator Thomas, was submitted to the Senate on Aug. 22. Other members were Senators Reed (Mo.), Smith (Ga.), New (Ind.) and Frelinghuysen (N. J.). The committee has found much to condemn and some things to commend and has not hesitated at favorable or unfavorable criticism wherever seemed to them to be deserved.

On the other hand, the report discloses little which is really new except in some added detail.

Its recommendation for the creation of an independent Air Secretary, with a seat in the Cabinet, is likely to arouse antagonism, but there are other recommendations which are acknowledged valuable on their face and will be less disputed.

— Only SE-5's and Handley-Page machines can be put in [illegible] production before 1919.

June 1, 1918

Inauguration of the Air Mail

The inauguration of the regular air mail service between Washington, D. C., and New York took place, as scheduled, on May 15.

Although no formal ceremonies attended the inauguration of the service, there was a large gathering of officials at both terminals. Among those present at the Washington terminal were the President and Mrs. Wilson, Postmaster General Burleson, Secretary of the Navy Daniels, Assistant Secretary Roosevelt, Major-Gen. W. L. Kenly, Director of Military Aeronautics, and representatives of the Aircraft Board, the National Advisory Committee for Aeronautics and the Senate and House Committees on Post Offices and Post Roads.

The machines used for this service were Curtiss biplanes fitted with 150 hp. Hispano-Suiza engines.

Since then the air mail has functioned with a sufficient regularity for such an undertaking to hold out favorable prospects for such additional air lines as may be organized in the future.

Two postal airplanes of a more powerful type, fitted with Liberty engines, have since been placed in service, and one of these machines flew on May 22 that day from Philadelphia to New York in 32 min., beating the best previous time by 29 min.

The success obtained in operating the airplane mail service, it is expected of the new route during its initial stages, said Postmaster General Burleson on May 29, exceeds what I expected of the new route during its initial stages. The army has rendered a splendid service, which is not only a distinct contribution to the commercial world, but is proving valuable training for the aviators who are about to enter upon a greater task in France."

Billion and Quarter for Aeronautics

[illegible] billion and a quarter dollars for aeronautics is [illegible] million [illegible] appropriation bill

May 15, 1919

Naval Transatlantic Flight Expedition

The transatlantic flight expedition of the United States Navy, consisting of seaplanes NC-1, NC-3 and NC-4, under the command of Commander John H. Towers, C. S. N., took off on May 8 at Rockaway naval air station, en route for Halifax, N. S., the first point of stoppage designated in their flight to Newfoundland. The trans-Atlantic flight proper will begin only at Trepassey, N. F., a distance of 1,008 nautical miles (1,150 Sta. miles) from Rockaway.

The three seaplanes started [illegible] 10 [illegible]

miles); and (3) from Lisbon to Plymouth, England, 775 nautical miles (891 Sta. miles). The total distance of the trans-Atlantic flight is to be 4,200 nautical miles (3,743 Sta. miles).

mon understanding, and for the improvement of their mutual relations. The somewhat chaotic conditions of the years immediately after the war have evolved into order through the five-year programs and the procurement bill of 1926. Although the question of procurement is by no means yet settled, and improvements in law and in method have still to be hoped for to insure the most equitable possible allocation of orders on the most equitable possible terms, the status since 1926 has been infinitely superior to that of the years immediately previous. The news pages for seven years after the end of the war recount the record of an endless series of dramatic accusations, scandals, and investigations. Since 1926 they have, on the whole, told a story of steady productive activity, broken only by occasional distressing sequels of unwise adventures in high finance. Ten years ago it was impossible for anyone to say in what direction the industry was headed or to guess how long the course would remain unchanged. Since the Morrow Board days we have sometimes found ourselves temporarily involved in the quicksands, but we have always been able to feel that we were making progress. With only slight and occasional deviations, we have kept moving steadily towards a soundly-organized industry, economically stable and stable in policy.

With the passage of the magazine into the hands of the McGraw-Hill Publishing Company, in the spring

August 1, 1917

, Manufacturers Aircraft Association, Inc., Organized

In view of several erroneous statements which have been made in the public press, relative to the Manufacturers Aircraft Association, AVIATION prints the following statement issued by the Chairman of the Publicity Committee, Fay L. Faurote:

At a meeting held July 24 in the law offices of Crisp, Randall & Crisp, well-known patent attorneys, the air manufacturers of the United States pooled their patent interests for the good of the Government and formed a new organization known as the Manufacturers Aircraft Association, Inc. By the terms of their agreement the various patents owned by the individual members are to be taken over and so cross-licensed that their use may be made universal to all engaged in the industry.

This action comes as a result of a number of conferences held in Washington by the members of the National Advisory Committee for Aeronautics and the officials of the Army and Navy and the Manufacturers Aircraft Association.

In January, 1917, the Secretary of War and the Secretary of the Navy requested the National Advisory Committee for Aeronautics to investigate the aircraft situation and recommend a solution for the problem in patent litigation which had arisen between the Wright-Martin Corp. and the Curtiss Aeroplane & Motor Corp. As a result of these meetings a special sub-committee on patents was established at a regular meeting of the Executive Committee on February 10, consisting of Charles D. Walcott, chairman; S. W. Stratton, S. D. Waldon, and Lieut. J. Towers, U. S. N. In May, 1917, Judge Benton Crisp, Frederick P. Fish (who was not able to serve, Charles Neave, his place) and Dr. W. to the sub-committ

decided to place the control of the association in the hands of three voting trustees, consisting of Judge W. Benton Crisp, Joseph S. Ames, professor of the Department of Physics of Johns-Hopkins University, whom it will be remembered was recently sent abroad by President Wilson as a member of a commission delegated to investigate scientific subjects, and Albert H. Flint, the vice-president of the L. W. F. Engineering Company and vice-president of the Aircraft Manufacturers Association.

Of these three, one represents the Manufacturers Aircraft Association, Inc., one the Curtiss and Wright interests, and the third is a neutral elected by the other two.

The directors of the Association are: Frank H. Russell, of the Burgess Co. of Marblehead, Mass.; Albert H. Flint of the L. W. F. Engineering Co.; John P. Tarbox of the Curtiss Aeroplane & Motor Corp.; Harry Bowers Mingle of the Standard Aero Corp.; R. S. Fow of the Sturtevant Aeroplane Co.; George H. Houston of the Wright-Martin Aircraft Corp.; H. E. Talbot, Jr., of the Dayton-Wright Aeroplane Co.

The officers of the Associa Frank H. Russell of the Burges dent; Albert H. Flint of the gineering Co., vice-presid Mingle, of the Standard urer; Benjamin S. F Aeroplane Co., sec L. Williams, assis

Judge W. B tees, well k

airplane manufacturers may not at this time be under any improper or unfair restraints.

All patent litigation relating to airplanes between members of the association ceases automatically, and the airplane industry is therefore left free to expand to any limits desired or required by the unusual demands of the war.

Major Foulois Head of Airplane Division

Major Benjamin D. Foulois has been named chief of the airplane division of the Army.

Goggles for Aviators

A goggle designed for use by aviators has several interesting features, different from anything previously produced. The glass used in this goggle has been tested by the Underwriters' Laboratory at Chicago and by the Army and other Government Labo

October 23, 1922

The Third Pulitzer Trophy Race

Lieutenant Maughan's Victory on Army-Curtiss Racer at 206 m.p.h. Proves America's Supremacy in Pursuit Aviation

By Ladislas d'Orcy

The third annual competition for the Pulitzer Trophy, America's classic airplane speed contest, strikingly vindicated the contention of those who have maintained all along that the United States possessed the engineering talent as well as the manufacturing resources and the pilots to enable it to affirm its superiority in the construction of the fastest airplanes in the world. What this primacy means was illustrated in a talk made by Brig. Gen. William Mitchell, Assistant Chief of Air Service, at the banquet of the Second National Aero Congress when he said that the safety of the nation depended primarily upon the development and the maintenance of a powerful pursuit aviation, the first line striking force of the nation in future wars.

The Pulitzer Trophy race this year was won by Lt. R. L. Maughan, A.S., whose Army-Curtiss Racer, equipped with a supercompressed Curtiss Model D12 engine, developing about 400 hp., averaged a speed of 206 m.p.h. Lt. L. J. Maitland, A.S., who finished second on a ship of the same type, made the fastest lap of the race at a speed of 216.1 m.p.h.

The day was almost ideal for the purpose of this extraordinary high speed race. While the practice [illegible] accompanied by threatening [illegible] and winds, Oct. 14, moderate wind had cr alike, [illegible]

September 25, 1922

Gliding Experiments in Europe - 1922

An Eyewitness' Review of the Results Achieved At the Recent French and German Gliding Meets

By Edward P. Warner

The art and practice of gliding are very old, their origin being lost in utter antiquity. The building and operation of gliders became a common pastime among school boys in the United States some fourteen years ago, when the inspiration of youth was fired by the demonstration of the Wright Brothers and their rivals and successors. The German flights in the Rhön began in 1920, and interest in soaring flight has been at a white heat to the east of the Rhine ever since that time. Only within the past two months, however, have the American people taken a real interest in this phase of aeronautics. The flights of Heutzen, Martens, Hackmack, and others in Germany, together with the holding of a French competition, have suddenly awakened enthusiasm for soaring flight over all the world, an enthusiasm which sometimes leads to hopes and prophecies overbalancing the work of present attainment. The achievements of this summer, particularly those of the three German pilots enumerated above, have indeed been marvelous, and soaring, gliding or sailplaning, call it by whatever name you will, certainly has taken a place in the aeronautical field. At the close of 1921 no one would have done during the past summer, and there has been no indication of approach to any achievement which would justify some of the wild predictions recently made. Wonderful as were the flights carried out by Heutzen, they do not mean that we are ready to cross the Atlantic without the expenditure of power, nor even that we have taken any real step toward the realization of a feat so extraordinary.

The results of the summer's experiments may be summarized in a few words. It has been proven that it is possible for a skilful pilot on a very efficient glider to remain aloft practically indefinitely over a favorable terrain of which the pilot knows every detail. Given these conditions, long flights are made by taking advantage of ascending currents. The theory on which the flights of Heutzen rest is the same as the theory which accounts for the ten-minute glide made by Mr. Orville Wright in 1911, but the advance of aerodynamic knowledge

April 9, 1923

New Type of Flying Machine—The Lacierva "Autogiro"

By Herardio Alfaro

In the past few weeks the Spanish aeronautical world has witnessed some highly interesting experiments with a new type flying machine which its inventor, Juan Lacierva, calls an "autogiro." A close-up view of this machine appeared on the cover of AVIATION for March 12, 1923, while the accompanying illustration shows the machine in flight.

In a series of tests conducted at Cuatro Vientos Airport, near Madrid, by Lieut. A. Spencer of the Spanish army, the Lacierva Autogiro left the ground easily, made turns around the field and landed smoothly. Its most interesting feature is its ability to land with practically no forward speed, the engine being shut off. The experiments showed that the Autogiro has remarkable stability, for it can be flown without the assistance of any lateral control (ailerons), and the elevator controls could be locked for any length of time without influencing the behavior of the machine.

The Autogiro Is Not a Helicopter

The Autogiro is not, as the first newspaper dispatches stated, a helicopter. In fact, the machine is based on principles entirely different from those followed in the construction

turn freely on its bearings. Consequently this "screw" is actually a wind vane which operates like the little propellers used to actuate the fuel pumps of aircraft engines, that is, it is the relative wind created by the forward motion of the airplane which causes it to rotate.

On the Autogiro the big wind vane is mounted in ball bearings and is not connected in any manner by the pilot. The blades of the vane are set at a fixed angle of incidence relative to the axis of rotation, but they are hinged to the bearing

of 1929, it acquired new resources and expanded its activities. The first volume averaged 20 pages of editorial matter per issue, the most recent volume averages 63. But some things remain unchanged. The first editorial in the first issue declared: "The future of the aeroplane will depend largely on the use that is made of the technical information that is being gatherer in all parts of the world. . . AVIATION intends to assemble this vast amount of material and make it useful to the constructor, the engine maker, the aviator, and the sportsman. It will follow construction both abroad and in the United States, and present the latest developments in accurate, scientific, and unbiased form. . . It is hoped that by undertaking this great task a stimulus will be given to the whole aeronautical profession, the members of which will find in the new publication a continuous source of reliable information as well as a medium worthy of receiving and transmitting to the aeronautical world the results of their valuable experiments, researches, constructional developments, and matured views on the many aspects of this great branch of engineering." Our scope has broadened greatly, and our responsibilities have increased, since that time, but we still count that ambitious declaration of fifteen years ago as a part of our present-day platform. There will be further expansion and change in the next fifteen years, but in 1946 our fundamental purposes will still be the same.

October 8, 1923

The United States Wins the Schneider Cup Race

Navy Pilots Secure First and Second Place in Curtiss Navy CR3 Seaplanes and Break Record for the Course

Lieut. David Rittenhouse of the United States Navy, piloting a Curtiss Navy CR3 seaplane at a speed of 177.38 m.p.h., won on Sept. 28 the Schneider Cup from its English leader against a field which had been reduced to another American, an Englishman and a Frenchman.

Lieutenant Rittenhouse crossed the finish line of the 190 nautical mile course in 1 hr. 12 min. 26 4/5 sec. Lieut. Rutledge Irvine, piloting another Curtiss Navy CR3, finished second, with a speed of 173 m.p.h., less than two minutes behind Rittenhouse, and the Englishman, Capt. H. C. Biard, [illegible] with Napier Lion engine, [illegible] out of action by an accident and was not [illegible] piloting a Supermarine with Napier Lion engine, finished third, 9 min. behind the winner. The Frenchman [illegible] believe that the race would be [illegible]

Wide World Photo

Curtiss-Navy racer, CR3 type (Curtiss D12 460 hp. engine) on which Lieut. David Rittenhouse, U.S.N., on Sept. 28 at Cowes, England, won the Schneider Cup Race, at a speed of 177.38 m./h.

AGITATION for a united air force was continuous from 1918. The bombing tests of 1921 helped it along. In 1924 AVIATION began to cry in the wilderness for a national air policy. In 1925 the Morrow Board laid the foundation for such a policy. In 1926 most of its parts were enacted into law.

March 31, 1924

LIGHT PLANES AND GLIDERS

Edited by Edmund T. Allen

The Right Kind of Light Plane

Interesting views on the development of a practical light plane are set forth in a letter from George B. Post, of the Huff Daland Aero Corp., who writes as follows:

"I feel that the right kind of small inexpensive airplane are going to do more to stimulate public interest in the usefulness and pleasures of flying than any other thing during the next few years. Light plane activities abroad certainly seem to substantiate the case.

"Interest in small planes has just barely been awakened in the United States. The idea has potential possibilities for a wonderful success if properly launched upon its way, but can just as surely be ruined by giving early publicity to the wrong kind of machine. Obviously the Air Races this fall at Dayton offer a wonderful opportunity to demonstrate to the public what can actually be done along these lines, but it is also perfectly evident to me that the light plane races, as they are now proposed, will most certainly encourage the design of airplanes which will not be suitable for commercial use.

"The useful light plane must be capable of slow, short landings and a climbing angle that will let it take off and get out of the most restricted fields—if it cannot do this its primary purpose is at once defeated. Speed is of course desirable, and other things being equal, the more the better, but in this kind of plane it is the height of folly to sacrifice the two fundamentals for a few extra miles an hour at the other end. Nevertheless, the present specifications for the Races, as recently printed in AVIATION, will most certainly award the prize to this kind of a plane, and I personally know of two machines which have been already laid down with this end in view.

"Why can't we have a *competition* instead of a *race*? Award the prize on a point basis, including quick take-off and climb, short landing and roll, high speed, efficiency of fuel consumption, maneuverability, stability, ease of maintenance, etc., etc., as design data by the ... above. It is felt that stability and control would be hard to pass upon in a contest of this kind, and that this idea therefore be eliminated, since where ...

September 22, 1924

Brief History of the Round the World Flight

World Fliers Covered 22,000 ... In 153 Days, Using ...

The pioneer flight around the world, organized by the Army Air Service with the assistance of the Navy and Coast Guard, was divided into five divisions: the flight across the Pacific, the water flight from Japan to India, the overland flight from India to England, the crossing of the Atlantic and the last lap across the American continent. As will be noted, more two thirds of the 25,000 mi. flight was over water. The route chosen for the crossing of the two great oceans led the fliers almost up to the Arctic circle, where they met almost insurmountable difficulties in the line of fog and bad weather. Such a course however was made necessary by the limited cruising range of the planes used. The overwater flight from Japan to India was accomplished on schedule and without great difficulty as were the two overland divisions of the flight. In fact, it was the two excursions into the far north which caused the fliers to fall behind their schedule. The elapsed time of the flight from Seattle to Boston was 153 days or a little over five months. During this time our world fliers flew on 45 days. An approximate estimate would seem to indicate that some 72 of the non-flying days were spent waiting for good weather, while 36 days were spent in making repairs and adjustments. The distance flown from Seattle to Boston is approximately 22,022 mi., which was flown at an average mile of speed of nearly

July 12, 1926 AVIATION 53

The Army Air Bill

Plan for Procurement of Aircraft Laid Down. Five Year Policy Settled.

THE ARMY Air Bill is a most comprehensive piece of legislation and will have an important effect on the development of aviation both in the Army and the Navy. In a general way the bill tries to do three things. First, to improve conditions in the service so that the flying personnel will feel that they are being treated fairly. Second, to lay out a continuous program for development during the next five years. Third, to so reorganize the letting of contracts to manufacturers that the industry may be put on a stable basis and that the maintenance of proper designing staffs may be encouraged. The clauses which deal with this third phase apply equally to the Navy for, at the time the Navy Air Bill had been passed, Congress had not decided as to how these matters were to be handled.

Competition in Design

The most important clauses in the Army bill as far as the manufacturers of airplanes, engines and accessories are concerned are those which deal with the methods of purchase. The bill is very detailed and specific as to how such matters ... be handled and is too long to reprint in full and ... summary of the methods to be used ... the Secretary of ...

If the Secretary finds that the winner is not capable of building the plane or if he is not able to reach a price for the ... ing which is satisfactory to the Government he is authorized to purchase the design at a price not to exceed that ... in the design competition. Any department of the ... ment may then build or have built planes or ... to the designs, while the designer may pat... shall be entitled to exclusive rights as ... the Government or its assignee.

In case the Secretary ... competition capable ... a satisfactory ... chase the design ... contract out ... conditions ...

July 25, 1921

Ostfriesland Sunk by 2000-lb. Aircraft Bombs

Martin Bombers of Army Air Service Sink the 23,000-ton Battleship in Fourteen Minutes

In the concluding phase of the bombing experiments conducted by the Army and Navy Air Services against warships of all types to determine the offensive power of aircraft the ex-German battleship Ostfriesland was sunk on July 21 by two 2000-lb. bombs dropped from Army Martin bombers. The bombardment had on the previous day been subjected to aerial bombardment with forty-one 230-lb. bombs and eleven 600-lb. bombs. Great damage was caused thereby to her superstructure, and many of her seams opened over night, for on the morning of the 21st the Ostfriesland was seen to have gone down two feet by the stern. The five 1100-lb. bombs which were dropped upon her on the morning of the second day of the bombing tests still further opened her seams, for she was at last ten feet down by the stern when the final test began. The two 2000-lb. bombs did their work quickly, for the 23,000-ton battleship went down fourteen minutes after the first of the two aerial bombs struck the water.

Thus was vindicated the contention of the students of aerial warfare who maintained that even the biggest and most powerful modern warship could be sunk by aircraft bombs provided the latter contained a sufficient quantity of explosive. While the previous destruction by aircraft bombs of a submarine, a destroyer and an armored cruiser proved the vulnerability of unprotected or incompletely armored vessels to aerial attack, practically every naval officer doubted that a battleship could be sunk by aircraft bombs. The proof to the affirmative which the destruction of the Ostfriesland affords is particularly instructive owing to the fact that the ship in question possessed unusually complete underwater protection, for the German naval design of the latter years has been noteworthy for the careful manner in which this question had been studied and solved. Admiral Sir John Jellicoe in his book "The Grand Fleet," comments on this point in connection with the battle of Jutland, where the British saw a number of German battleships in sinking condition and reported them as probable ... The German report on the battle ... a number of ... and ...

In view of this point, which it is not immaterial to stress, the sinking of the Ostfriesland by means of two one-ton aircraft bombs, each containing 1000 lb. of TNT assumes particular significance. The keynote of comment in which groups of air officers and aircraft men indulged after the bombing tests was sounded by General Williams, Chief of Ordnance U. S. Army, when he said:

"A Bomb was Fired Today . . ."

"A bomb was fired today that will be heard around the world. It is a heavier explosive charge than has ever been delivered against a battleship. Its sinking of the Ostfriesland means that the capital ship now faces a new menace that must be guarded against by every possible study and effort.

"The biggest mine exploded against battleships weighs 500 lb.; the biggest torpedo, 500 lb.; the heaviest depth charge, 300 lb., and the biggest charge ever fired from a big gun was 1900 lb., fired from the big Gathmon experimental gun. Today we have seen a 2000-lb. bomb, half of whose weight ... having been carried by an airplane 100 miles from base out to sea. The thing today was the carrying of a mine of unprecedented size out that distance in land planes and putting it down successfully. Stop and think what that all means."

Air Commodore Charlton, British air attaché at Washington D. C. echoed General Williams' views by saying:

"My only comment is that this shot will ring around the world. That's been said before, but it's true."

First Day of Bombing

The bombing tests with the Ostfriesland began on ... when the vessel, which was anchored some 70 miles ... Virginia Capes, was subjected to aerial attacks ... lb. bombs and then with 600-lb. bombs. ... were used by ...

January 2, 1922

Aeronautical Chamber of Commerce Organized

National Body Comprising over 100 Charter or Founder Members Embraces Entire Industry

Organization of the aircraft industry into a national body known as the Aeronautical Chamber of Commerce of America, with approximately 100 charter or founder members embracing the designing, constructing, operating and kindred elements, and representing virtually every section of the United States, was announced Dec. 27 at the Executive Offices, 501 Fifth Avenue. Among other things, it will develop the market and increase the use of flying machines among civilians, corporations and transportation companies.

The aircraft industry then follows the example of all other modern industries which owe their present greatness in no small measure to the trade association. Organization of the Aeronautical Chamber of Co... following as it does ... in the Navy ... creation of the Bureau ... ment ...

"The existence of the Manufacturers Aircraft Association partly met the need. Its work has been, characterized by ... broad public-spirited attitude toward the entire industry ... has been effective, but its membership ... that an organization limited ... planes, having, primarily ... of licensing ... to ...

July 21, 1924 799

A Suggested National Air Policy

That a National Aviation Policy is needed by the United States is obvious. To get such a policy in concrete form AVIATION *requested several thoughtful friends of aeronautical progress to make suggestive and constructive recommendations. Some of them are given below and will be printed each week with additions, omissions and such other changes as appear to be helpful toward the formulation of a sound national air policy. Readers of* AVIATION *and others can render no greater service to the cause of aeronautical progress than contributing their comments and suggestions.*

GOVERNMENTAL.

A continuous program of aircraft development both governmental and commercial.
A civilian, charged with championing a national air policy, is needed in the Government.
Aircraft committees in the House and Senate to hold aircraft hearings where civilians as well as government officials can express their opinions.
A detailed aircraft budget for all Governmental Departments, and an annual statement of all expenditures.
An experienced staff of flying officers at the head of all governmental air defense services.
Coordination of all procurement and experimental aircraft work of the government under one agency.
Limitation of government manufacture to repair of aircraft and specialized work that cannot be done by private firms.
The elimination of the duplication of aerial functions and facilities by government departments.
A country wide Air Mail system of trunk lines connecting the principal cities of the country.
Establishment of a National Airway System through cooperation of the Federal Government with States and Cities.
A national aircraft law that will regulate aviation, administered by practical pilots and experienced aeronautical engineers.
Membership of the United States in the International Convention for Air Navigation.

COMMERCIAL AIRCRAFT OPERATION.

Creation of commercial air lines by private enterprise or government subsidy.
Encouragement of participation by private companies in aircraft races and competitions.
Encouragement of the training of pilots by civilian schools.
Creating an Esprit de Corps among flying men all over the country by frequent gatherings at aviation meets.

INDUSTRIAL AIRCRAFT CONSTRUCTION.

Recognition that a sound aeronautical industry is a prime necessity of our National Defense.
An active industrial association that will coordinate the aircraft industry and defend it from attack.
Encouragement of the designing of new types of aircraft by manufacturers by allowing them to retain their proprietory rights.
Concentration of manufacturing firms on specialized types of army and navy aircraft.
Encouragement of research by constructors, universities and other agencies as well as by the government.
Encouragement of an annual design competition for commercial aircraft.

CIVILIAN.

A national aeronautical organization composed of public spirited citizens that will take a strong position of leadership on national aeronautical policy.
An Annual Aviation Week during which the country will think of aerial progress.
The formation of local aero clubs by fliers for the purpose of stimulating flying in all localities.
Encouraging the public to fly and patronize the air mail and transport facilities.

September 3, 1924

The Future Market for Airplanes

Private Planes Held to Offer the Best Prospects

By EDWARD P. WARNER

Professor of Aeronautics, Massachusetts Institute of Technology

The violent deflation which has succeeded the forced development of the aircraft industry during the war has been a world-wide phenomenon. The problem of the sudden annihilation of the demand for aircraft has been met in different ways by different countries, but all manufacturers, of whatever nationality and whatever the measures that they may have taken for meeting the immediate financial emergency, have been busily engaged in endeavoring to forecast the future. Everywhere there has been a search for new markets. Everywhere there has been profound and anxious speculation on the probable future importance of markets already existent in some degree.

Military Demand

First among the possible markets for airplanes in any country, under present conditions, are the army and navy, or the independent air force where one exists. They will continue to buy, but in quantities unlikely materially to increase. Purchases for military purposes may even fall off in number as the tension among the European states decreases, ... certain to do so if a conference for the limitation ... should be called and lead to definite ... work, instead of concentrating purchases and dooming the ... neglected builders to early extinction.

Continuance of present practices in the placing of ... still neglecting the possibility of selling airplanes ... buyers than one's own Government, ... still further decrease in the number ... and a growing domination of ... panies. There seems to be ... unless appropriations for ... either increased or distributed ... firms that all alike will ... the shops too small and ... of technical staffs ... factory completely ... involving ... of the ... if the ... be ... ex...

September 28, 1925 AVIATION 385

President's Air Board Commences Sessions

Hopes to Make Recommendations Before Congress Meets in December

THE special Air Board appointed by the President to make a far-reaching inquiry into the aviation services of the Government, with relation to national defense, met with Mr. Coolidge at the White House on Sept. 17, later held a meeting of its own choosing Dwight W. Morrow as its chairman and deciding to begin hearings, open to the public, on Monday, Sept. 21.

It was said by the board that all the sessions of the investigation will be open. The hearings will be held in the room of the House Interstate and Foreign Commerce Committee and the first witnesses called will be ... officials of the Army, Navy and ... Air Services.

There was a full attendance of the board at the first session. Those who are associated with Chairman Morrow, Vice Chairman Davison and Secretary Durand in this investigation which is expected to attract widespread attention, are Major Gen. James G. Harbord, former Chief of Staff of the Army; Rear Admiral Frank F. Fletcher, U.S.N., retired; Howard E. Coffin, aeronautical engineer; Senator Hiram Bingham of Connecticut, and Representative Carl M. Vinson of Georgia, Democrat, and Representative James S. Parker of New York, Republican.

Present indications ...

FROM 1925 to 1927 were the greatest years in American aeronautics. The first air mail contracts were let, and air transport went on a commercial footing. The Department of Commerce took over airway development. The great oceanic flights were made. The triumphs since then have come as the inevitable sequel.

October 12, 1925

Ford Sees New Air Epoch

"The fact that so many airplanes entered in the first commercial airplane reliability tour returned successfully after having flown more than 1,900 mi. in a week proves that airplane transportation not only is safe, but that it is reliable," Henry Ford declared after all but two of the ships entered in the tour for the Edsel Ford trophy landed at the Ford Airport.

"We have been experimenting with an 8-cylinder air-cooled motor of 200 hp. for some time," he said, "and tests prove it to be highly satisfactory. It is a double-V type, or like two X's, one back of the other. It has a double crank-shaft and vibration is practically eliminated.

"I'm a greenhorn at this aviation business, but I can see that it is going to be a great industry.

"It's bigger in possibilities than anything else in the world; too big to be a one-man patent affair; too big to be any one man's contribution to the science

... Parasites

who is mainly responsible for what we are doing."

"What do you think of the ... lecture of an airship larger than ... Shenandoah by the navy?" he asked.

"The ... to do it," ... it should ... about ... ...

AVIATION October 19, 1925

The New Air Mail Contracts

Eight New Air Mail Contracts Awarded

FURTHER extension of the Air Mail Service of the United States was assured as a result of the action of Postmaster General New in awarding the contracts to private corporations to operate air mail service on five of the eight commercial routes for which bids were recently opened at the Postoffice Department. The contracts awarded were divided among five different operating companies and are designed to supplement the air mail service already being furnished between New York and the Pacific coast and inter-

sections of the country marks an epoch in the history of the American post office. Upon the result of the enterprise day entered upon depends the future of aerial transport in the United States. Because of the importance of the ... and because it is the first time the ... problem before it, ... ularly carried out ... and critically ... that has ... have had ...

AVIATION May 24, 1926

Civil Aviation Bill Passes

Bill Passes Through Conference and is Ready for President's Signature

IN DECEMBER, the Senate passed the Bingham Bill regulating civil aeronautics. This Bill was published in AVIATION, Dec. 28, 1925. In March, the House passed the Merrit-Parker Bill, which was published in AVIATION, March 22. The two bills went into a conference of the Senate and House and the compromise bill is now ready for the signature of President Coolidge. The bill will undoubtedly be signed and will then be published in full.

The following statement of the ... indicates the differences in the ... which were reached ...

The House amendment provided for such registration in ... of a corporation ... per cent of the voting stock is ... trolled by citizens ... United States. The ... requires 51 per ... citizens of ...

AVIATION June 20, 1927

United States to Europe and Return

A Land, Sea and Air Log of Colonel Chas. A. Lindbergh's Great Adventure

Friday May 20

TAKES OFF from Roosevelt Field, L. I. in Ryan monoplane (Wright Whirlwind) "The Spirit of St. Louis" at 7:52 A.M., New York time, on the first leg of his history making non-stop flight to Paris. Passes over St. Johns, N. F. and heads out to sea at about 7:15 P.M., New York time.

Saturday May 21

After flying alone for 3,610 mi. over land and sea, 1,600 mi. of which were through rain, sleet and fog, he lands at

On the way to France

Le Bourget Field outside of Paris, France, at 5:21 P.M., New York time. Total time of the flight 33 hrs. 29 min. 30 sec. Over 100,000 people swarm over the field when he lands and it is two hours before he can reach the American Embassy where he becomes the guest of Ambassador Herrick.

Sunday May 22

Arises refreshed from ten hours sleep and appears on the balcony of the Embassy and acknowledges the ... thousands who are waiting outside ...

his mother by radio-telephone and pays a visit to the ... of Captain Nungesser, whose fate ... ful flight from Paris to New Y...

Goes out to ... finds that the ... little damage ... Doumergue, ... Cross of ... France ... of leading ... at the ...

Receives ... Secretary ... aboard ... steamer ...

October 17, 1924

ZR3 Reaches Lakehurst from Germany

Last Zeppelin Covers 5000 Miles in 81 Hours Across Atlantic

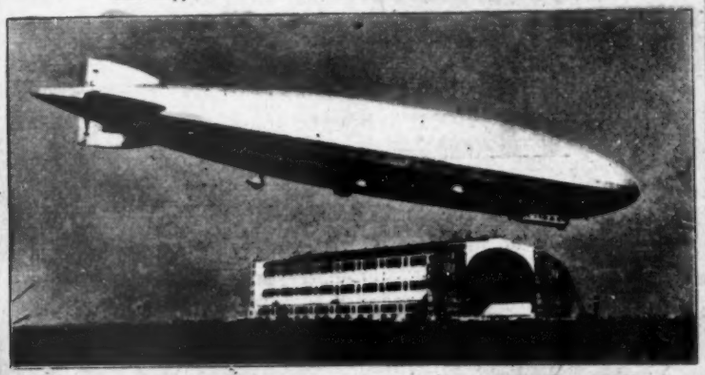


Photo Kadel & Herbert

The ZR3 arrives at the naval air station at Lakehurst, N. J., her new home, after an 81 hr. flight from Friedrichshafen, Germany

The reparation airship ZR3, the 126th airship of the series built by the Zeppelin Co., which left Friedrichshafen, Ger., sunny, on Sunday morning, Oct. 12, reached the naval air station at Lakehurst, N. J. on the following Wednesday morning, having covered the intervening 5000 mi. in 81 hr. 12 min. Dr. Hugo Eckener, one of the Zeppelin Co.'s veteran pilots ... Willy Speyer, chief radio operator. Leonhard Freund, radio ... Johann Ludwig, ... Gustave E. Reh... Zeppelin Co. ... August ...

December 1, 1924

A New York-Chicago Night Air Mail Service

New Schedule, Wanted by Business, to Start Early Next Spring

Overnight Air Mail service between New York and Chicago, to start early next spring, was announced Nov. 14 by Carl F. Egge, General Superintendent of the Post Office Department's Air Mail Division. Mr. Egge has just completed his report to Col. Paul Henderson, Second Assistant Postmaster General, embracing plans for illuminating the 780 mi. route and working out emergency landing fields.

The Overnight Schedule

The time required for the flight westbound will be 9 hr. and the time eastward, 8 hr.—due to prevailing winds. The fastest rail time between New York and Chicago is 20 hr. The mail planes will leave the New York terminal at 10.80 p. m. E.S.T. and arrive in Chicago at 6.00 a. m. C.S.T. They will leave the Chicago Terminal at 9.00 p. m. C.S.T. and ... rive in New York at 6.00 a. m. E.S.T. Delivery ... by the first carrier trip. The postage rate will ... same as for the present day flying—eight cents ... fraction thereof.

The present transcontinental service will be continued ... out change.

"We have completed four months of regular day ... flying between New York and San Francisco and ... tions have been generally so satisfactory that we ... confident we can fly on schedule by night over the ... Mountains," Superintendent Egge said, announcing ... Air Mail schedule.

Business Keen About New Service

"The present transcontinental schedule calls for ... from New York and Chicago, respectively, at 10.00 ... 7.30 a. m. Arrival at each point is too late for ... same day. Business houses, bankers, shippers, ... the average of 32 or 33 ... great advantage, ... as to overnight ...

field, marking the landing tee will be a depressed ... red light. On a 50 ft. tower will be one 500,000,000 ... power electric are beacon, ... revolving three times a minute around the horizon. ... ground, for floodlighting, ... power beacon. Buildings ... all be flood lighted.

"Bellefonte, Pa. ... main field and ...

June 19, 1928

Southern Cross Airmen Land at Sydney Completing 7,000 Mi. Trans-Pacific Flight

CAPTAIN KINGSFORD-SMITH, Charles T. P. Ulm, Harry W. Lyon, and James Warner completed their trans-Pacific flight of 7,000 mi. from Oakland, Calif., when they landed in their tri-engined Fokker monoplane Southern Cross at Sydney, Australia, their goal, on Sunday June 10. The fourth and last leg of their great flight was a comparatively short hop of 800 mi. from Brisbane, Australia.

As we go to press, the fliers are preparing for a visit to Melbourne, which lies some 660 mi. from Sydney. At this point, Lyon, navigator, and Warner, radio operator, both Americans, plan to conclude their trip by air. Captain Kingsford-Smith and Charles Ulm, however, report they will continue in the Southern Cross in a journey around the world. After a visit to New Zealand, the Australians there plan to fly to Europe by way of India and Egypt, and to continue from there to America in a trans-Atlantic flight.

The four airmen left Oakland, Calif., on May 31 and landed at Wheeler Field, near Honolulu, less than 26 hr. later. The second leg, begun on June 3 from the Barking Sands runway, Kauai, Hawaiian Islands, took the fliers over 3,126 mi. of ocean to Suva in the Fiji Islands, where they landed in the Southern Cross on June 4 after 34 hr. 23 min.—the longest over water flight ever accomplished. Since the International Date Line had been crossed en route, it was June 6 in the Fijis when they arrived, a day then being lost.

Following a day's delay in obtaining a fuel supply from the steamer *Pioneer*, the four took off from Suva and flew to Nausai Beach, 16 mi. distant, from which they ... take off for the 1,762 mi. flight to Brisbane. ... everything was in readiness, and with 900 ... and 32 gal. of oil, the Southern Cross ... fine three mile sand runway of Nausai ... way to Australia. The flight ...

AVIATION

Radio Direction Finding

The Superintendent of Radio, Air Mail Service, Reports Results of Experimental ...

THE result of several years of experimentation in radio direction finding, with a view to furnishing added safeguards to mail pilots and planes, are contained in a report made recently to W. Irving Glover, Second Assistant Postmaster General, by Eugene Sibley, Superintendent of Radio, Air Mail Service.

It is the belief of Post Office Department ... time is not far distant when radio will be ... in keeping air mail pilots on their course ... them to safe landings in fog and other ... where visibility is bad.

... than from the other. The loop transmitter is directional in the same way as a receiving loop; i. e., maximum transmission in its plane and decreasing to zero at a right angle to the plane of the loop. The maximum and zero ... is broad and the decrease is greater per degree ... ninety degree position ... the bisector ...

106 AVIATION January 25, 1926

Daniel Guggenheim Gives $2,500,000 to Foster Aviation

Board of Trustees to be Unhampered in Its Disposal

DANIEL Guggenheim announced Jan. 17, in a letter to Secretary of Commerce Hoover that he had set aside $2,500,000, and stood ready to supply an additional $2,500,000 as the Daniel Guggenheim Fund for the Promotion of Aeronautics, to foster the science of aircraft until flying freight and passenger services can be placed on a self-supporting basis.

Mr. Guggenheim predicted that flying would establish itself as an independent industry within about ten years. At the end of this period of development Mr. Guggenheim intends that the fund shall terminate its existence. During this period his trustees are free to spend principal as well as interest to promote aircraft development.

Last summer Mr. Guggenheim gave $500,000 to establish a school for aeronautics at New York ... [illegible] ... purpose of ...

... can only develop in a primitive way." There is undoubtedly a function in this situation which the Government alone can perform.

Quotes President's Board

I have also been much impressed by the question raised and the answer given in the report of the President's Aircraft Board, which, as of Nov. 30, 1925, said:

"How can the civilian use of aircraft be promoted? This ... may well be the most important question which aviation presents in its far-reaching ... to our people.

The great flight

"HAPPY," observed some sceptic, "is the nation that has no history." The same may be said of long-distance flights. They are successful in proportion as they are lacking in dramatic feature, excitement, or suspense. By that standard, the performance of Messrs. Post and Gatty attained the very highest measure of success. A little fog over the Atlantic, a little uncertainty about the location over England and Germany, a little mud in eastern Siberia, a little propeller damage in Alaska, proved only trivial disturbances. It is a difficult subject for editorial treatment, for although the idea of circumnavigating the world in less than nine days, barely one-tenth of the time that Jules Verne allowed his hero, is full of the essentials of drama and romance, there was nothing dramatic about the accomplishment. It was the very perfection of adherence to plan. Post and Gatty made a schedule and they followed it. It was all as simple as that.

We call this the great flight. Not *a*, but *the*, great flight of the last three years. We couple it only with that brilliant triumph of organization and collective training, the Italian squadron's expedition from Rome to Brazil during the past spring, and with Coste's 3,600-mile struggle into the teeth of the prevailing wind last summer. The flight around the world was one of the few superlative achievements so far listed on the pages of aeronautical history, along with the exploits of Alcock, Lindbergh, and Kingsford-Smith. For Post and Gatty, places in Valhalla are securely reserved. The flight shed equal lustre upon the men and their equipment. It is an accomplishment that deserved world-wide appreciation, and it is disheartening to have to report an apparent campaign of deliberate belittlement in a section of the European trade press.

Though it is hard to pick out a single feature where everything appears to go so smoothly, the navigation certainly calls for special comment. Never before has there been such long-continued, quick, effective use of celestial navigation methods in the air. Few if any long flights over water and over desolate and unmarked country have been held so closely to a known and predetermined course. Harold Gatty joins Sir Arthur Whitten Brown, Lieut. Albert Hegenberger, Admiral Coutinho and a few others in the select company of the great pathfinders of the air.

We have been uniformly opposed to hops across the North Atlantic by land planes. Even in the event of success, nothing new is accomplished. Our news columns have been, and will remain, closed to any report of the doings of the pilots who embark upon those ventures. The Post-Gatty flight is in a different category. It had a new and definite objective, it was planned in all possible detail, and the hazards of the Atlantic crossing were only a minor incident of the story.

However great our admiration for an exploit like this, we are slow to dwell upon its "commercial significance." Such flights are a great test of the men and a test of the machinery, and they bear evidence upon the qualities of both, but it is altogether too easy an assumption that they are simply the forerunners of regular commercial operation. It is four years since Lindbergh flew from New York to Paris, and since the newspapers were filled with prophecies of early regular commercial operations without stop across the north Atlantic. A realization of those glib promises still looks very far away. But in this case the flight serves another purpose. It calls attention to airlines that already exist over the greater part of the round-the-world route. The phrase "remote places of the earth" is fast becoming an anachronism, and names that once represented only glamourous spots on the map, occasionally reached by great explorers after terrible hardships, now correspond to airports where mail planes arrive and depart at daily or weekly intervals. Regular service shuttles to and fro from Moscow to Irkutsk. Airlines tie the cities of the United States and eastern Canada directly to the Yukon territory and to the mouth of the McKenzie River, where ten years ago canoe and dog-sled offered the only choice in transportation. They run over Brazilian jungles and over the deserts of the West Coast of South America, and link the two together with a crossing of the high Cordillera. Post and Gatty received an excellent quality of aviation gasoline on the flying fields at Novo-Sibirsk and Khabarovsk, and in central Alaska they found a store of spare parts and a quality of mechanical service worthy of a metropolitan airport.

If Post and Gatty had done nothing else, we should render homage to them for having brought us the most forceful and dramatic of all possible reminders that air transport is sweeping away the last frontier, and bringing nations at the antipodes closer to each other than were neighboring villages three or four generations ago.

The patent racket

AMONG seekers after cheap publicity, sounding the alarm of "racket" now ranks second only to "red" baiting. At the risk of being accused of joining this class, or of being "put on the spot" by the Patent Lawyers Protective Association, some comment seems necessary on a situation connected with the granting of patents which now results in material economic loss to a group of persons who can ill afford it.

No one wishes to discourage the development of new ideas, or to withhold the right of an inventor to protect his "brain children" from willful or unintentional adoption by others There are indications, however, of a growing tendency of certain patent lawyers, especially those who maintain great organizations and advertise copiously, to take advantage of the enthusiasm and lack of education of many of the people who rush to them with inventions. Their optimism is capitalized

by encouraging them to apply for patents on ideas that are basically unsound, and which obviously will never yield the inventor anything but a bill for services rendered by the attorney.

In the aeronautical field alone over 160 patents have been granted in the course of the last three months. We have carefully studied, analyzed and classified them. The first attemption was to distinguish between those patents which were based on sound theory, engineering, or experience, and those which were obviously the product of imaginations totally unacquainted with even the most elementary knowledge of aerodynamics or mechanics. Some difficulty arose, however, in making a hard and fast discrimination between the two, and a third, intermediate class of "border line" cases was set up. This group contains ideas that may have some practical application in the future, although there is considerable doubt as to whether any appreciable percentage of them will ever reach the stage of practical use. It is significant to note that the majority of patents classified as sound involved improvements in structure and details of existing designs, and arose, in most cases, out of the work of established manufacuring or research organizations. On the other hand, those classified as impractical contained an amazing number of freak flying machines which carry one back to the days of Darius Green. Only 37 per cent of the total were obviously sensible,—17 per cent represented the border line group, and 46 per cent could be classed only as hopeless freaks. Of schemes submitted by individuals to goverment departments not one out of forty could ever be of any conceivable use.

Anyone who sees and talks to a few typical examples among the men whose invention belong to the latter class will be more inclined to pity than to ridicule them. Sincerely convinced that they have actually stumbled on something of revolutionary importance, they deprive themselves even of proper food to find the funds for developing the big idea. Frequently they assert confidentially that the particular invention at hand is really incidental, important though it may be, and the big thing which they have accomplished is a perpetual-motion machine, which is actually perfected but for which they lack only the necessary funds for construction. What an opportunity for a conscienceless lawyer. A few skilled words of encouragement and another useless invention is added to the already bursting files of the patent office, and the cash registers click merrily as the fees come in. Today, the average cost of obtaining a patent is about $200. Taking into account only schemes obviously impractical, during the last three months alone it has cost high school students, garage mechanics, fruit vendors, and what not, over $15,000 to protect aeronautical ideas which, in the aggregate, are scarcely worth the paper they are printed on.

It is quite obvious that the patent lawyer is not equal to the task of separating the sheep from the goats. Even if he were always an honorable and upright man, putting his client's interests ahead of his own (and unhappily that is not the case), he lacks the specialized technical knowledge to undertake that responsibility. The average inventor in the "freak" class, fearful that the fruits of his labor will be snatched from him, is wary of seeking advice, and is primarily concerned with protecting his idea at all costs. A great deal of money could be saved to individuals and the patent office machinery could be cleared of much of the trash which now encumbers it if there were available to inventors some trustworthy group of technical advisors who would pass on the practical merits of ideas submitted to them. The national engineering societies today have all the necessary machinery set up to perform this function. They have access to highly trained men of unquestioned reputation in all fields of engineering, and very little in the way of additional organization would be required to establish such a service. If by some means they could keep even a part of the "freak" inventors out of the hands of the patent racketeer the effort would be worth while.

Three cheers for the kindergarten

INTENSIVE development of the light plane is one of the major features of the aircraft industry's record for 1931. Excellent light airplanes have been placed on the market, but we cannot agree with any sales strategy which seeks to force these planes directly into the hands of novices. Early spring estimates of the light plane market reminded us only too forcibly of the estimates of prospective aircraft sales that were commonly made and accepted in 1928 and early 1929. We do not believe that the time has come to attempt great quantity sales of light aircraft to the uninitiated general public. Neither the planes nor the facilities for their proper maintenance and operation are ready for general public acceptance. Any fundamentally new type, no matter how perfectly and pleasingly it has been designed and built, should have a full season of operation in the hands of qualified members of the aviation industry before it is ready for widespread introduction to beginners with no previous aeronautical interests.

There are sales outlets within the industry for a very handsome number of light aircraft. They are making it possible for schools to offer instruction at very low rates, and for service companies to offer planes to rent for solo work at prices far beneath those now in force. The wider development of cheap flying schools and of fly-it-yourself services which is made possible by intelligent use of the light plane will do much to establish the service and repair facilities which amateur flying requires.

Proper application of the light plane by the industry itself will provide the amateur with an aeronautical

"kindergarten" where he may fly cheaper and easier than under any plan now in force. This natural development will make it possible for some thousands of people to learn to fly and to continue flying at very little expense and without actual ownership. A season of light plane operation by schools and service companies will produce many legitimate prospects for the purchase of private planes, and will at the same time serve to develop the planes themselves.

A great deal of harm may be done if light airchaft be handled irresponsibly, and with no idea except to push them out of the factories as rapidly as possible. A great deal of good will certainly be accomplished by a vigilant and conservative development.

The future of motorless flight

ON the second of August, the second national soaring contest will begin. It will continue for two weeks. Again, as in 1930, Elmira will be the scene, and the slopes of the valley of the Susquehanna will furnish the rising currents that are the motive power for soaring. More than any previous event, the Elmira meet will determine the future of soaring in the United States. Its propects hang in the balance. There are individuals and companies in the aeronautical industry that are already disappointed, and even disgusted, at the failure of gliding to make good on the roseate hopes of a year or two ago. If they are to furnish support, or even sympathy, they will have to be reconverted. Others are still sympathetic, but eminently skeptical. The industry originally approached the subject in the expectation of a large and direct return, either from the building and selling of innumerable gliders or from the training of even more innumerable pilots who would in short order go on to the powered airplane. That proves to have been pure illusion.

What then is the future of motorless flight? It may be a sport, a branch of research, a public spectacle, or a form of training for pilots. It may even be all four, but one thing that is perfectly clear is that it cannot be all four in the same place, time, and manner. The various fields of employment are distinct problems.

As a spectacle, the glider has already shown its possibilities. For some time, any airplane-towed flight would hold a crowd. More recently it has been necessary to complicate the menu by acrobatics. We have already made our opinion on that form of display plain on a great many occasions. Whether the craft is a powered airplane or a glider, public exhibitions of stunting do no good to commercial aviation and none to the industry. If the function of the glider in the United States is to add another ring to the aerial circus, then it deserves no support from the industry or anyone else, and the sooner that it disappears the better. Fortunately, the promoters of the meet at Elmira have resisted the temptation to increase the gate receipts by organizing on an acrobatic basis.

On the usefulness of the glider as a training device there is a great deal of conflicting evidence, but we pass over that without comment, for the use of gliders for elementary training has very little to do with a national soaring contest. The science and the sport, on the other hand, are very definitely connected with the events held at Elmira. The competition should furnish fertile ground for soaring research, and a great deal of useful information should be drawn from the reports of the competing pilots, but soaring research in America will go very slowly until it receives governmental or institutional support. In Germany it has been generously backed by the government, and several technical schools have made direct contributions on their own account, and the results have been amazing. It ought to receive the attention of the National Advisory Committee for Aeronautics here, and certainly it should become the subject of study by the aeronautical departments of some of our universities. The field is a virgin one, and even $15,000 or $20,000 a year from institutional sources, expended under the direction of competent aero-dynamicists and meteorologists, would go far to explore it.

But even this is incidental so far as Elmira is concerned. The most immediate prospects of soaring flight are as a sport, and it offers the best possibilities we see at the moment of introducing pure sporting competition into the field of American aviation, where it has so far been grievously lacking. "Sportsman-pilot" races have been held, but they have been infrequent and attracted but little attention. Soaring has all the desirable elements of an engrossing sport. It depends more on personal skill than on the performance of the aircraft. It is not unduly expensive. It presents to the participant a constantly varying problem, changing with every change of wind. It ought to be self-sustaining on a non-commercial basis, carried by the contributions of the competitors precisely as yacht racing is. It ought to be a helpful adjunct to the airplane industry, by giving a new interest to personal flying and by bringing a new and valuable element into the aeronautical world. The man who flies a glider for competitive sport will very soon want to have and fly an airplane for transportation.

But all this is for the future. It is a future full of attractive possibilities, but if it is to be realized we must first show the possibilities to those whom we want to attract. We must see to it that the professional demonstrations of soaring flight get a maximum of public attention. The airplane industry, and the operators of airplanes, will be doing themselves a very good turn if they exert themselves to draw notice to the Elmira meet and if they favor it with their own presence, as participants or as spectators, in every case where that is practicable.

News of the Month

Aviation history begins a new chapter

Eight days, 15 hours, 51 min. after they had taken off for Harbor Grace on the first leg of their round-the-world flight, Wiley Post and Harold Gatty landed again on Roosevelt Field. Their Lockheed-Vega monoplane, the Winnie Mae of Oklahoma, had covered 15,474 miles at an average speed of about 146 m.p.h. Flying over some of the most hazardous seas and least known countries of the globe at heights varying from 11,000 ft. to barely enough to clear the surface of the ocean, they shattered all previous records. The time was thirteen days shorter than that of the Graf Zeppelin and fifteen days better than the previous airplane record of Mears and Collyer, who shipped their craft across the Atlantic and Pacific oceans.

The Winnie Mae, powered by a Wasp engine, made the trip virtually without mishap. (An account of the mechanical preparations for the flight is given on page 468, a tabulation of the stages flown, on page 455).

In his quarters behind the tanks, navigator Gatty had most of the instruments known for use in aerial navigation, including a radio sending and receiving set and facilities for telephonic communications with Post forward in the pilot cockpit. The plane as it took off, complete with Post and Gatty and provisions, weighed more than three tons.

More than a third the distance of the Post-Gatty round-the-world flight was covered over Marignane, France, by two French fliers attempting to break the world's non-refueling endurance flying record recently established by Lees and Brossy. Joseph Lebrix and Marcel Doret were in the air 70 hours and 10 min., and though lacking 14 hours and 23 min. of equaling the previous endurance record, set a new figure for the world's closed circuit distance. Their 650-hp. Dewoitine monoplane covered 6,500 miles, exceeding by a considerable margin the former record of 5,564 miles held by Paillard and Mermoz.

Intercity records fall

New city-to-city records are also being established in Europe. Capt. T. Neville Stack and J. R. Chaplin flew a British Vickers-Napier mail plane from London to Warsaw and back, a distance of about 2,000 miles, in 15½ hours, averaging 130 m.p.h. for the trip. Capt. Frank M. Hawks satisfied his ambition to breakfast in London, lunch in Rome, and return to London in time for tea, making the 1,900-mile round trip in 9 hours and 44 min. at an average speed of about 190 m.p.h.

Back on the American continent, Captain Hawks continues to break records and eat from place to place. Rising in Quebec, he flew to Montreal for breakfast, to Toronto for luncheon, to Ottawa for tea, and back to Montreal for dinner. He covered about 850 miles in 4 hours and 18 min., each leg of his trip making a new record, with the exception of the Toronto-Ottawa hop which lacked four minutes of the best time for the route. Even his return to New York brought a new record to Captain Hawks, when he flew the 350 miles from Montreal in 1 hour, 45 min., considerably faster than any previous time.

A Lockheed Altair monoplane with retractable landing gear, flown by James Hall, on June 19 set a new unofficial record for the north to south hop across the United States. The 1,300 miles from Vancouver, B. C., to Agua Caliente, Mexico, were covered in 7 hours, 48 min., 1 hour and 26 min. better than the previous record held by Col. Roscoe Turner.

Achievements, present and past

The Grover Loening Intercollegiate Trophy, awarded annually to the college flying club which has been most successful in inducing members to become pilots and student pilots, to be presented at the National Aeronautic Association banquet in Washington on July 23, goes for the second consecutive year to the Harvard Flying Club. The Harvard club, the oldest college flying organization and the only one owning planes outright, includes in its membership 40 licensed pilots who flew a total of 1,448 flying hours during the past year. It has a record of about four years of constant flying, marred only by one fatal accident during the past spring.

A record flier of 22 years ago was M. Louis Bleriot, whose tractor monoplane was the first to fly from France to England. An exact replica of the Bleriot XI of 1909, a flimsy affair beside even the lightest of modern light planes, was flown by M. Quatremarre during a meet at Hanworth Park, in England.

Calendar

July 1-Sept. 8	Trans-Canada Air Pageant.
Aug. 2-16	Second Annual National Soaring Meet, Elmira, N. Y.
Aug. 29-Sept. 7	National Air Races, Cleveland Municipal Airport.
Sept. 1-3	Twentieth National Aeronautical Meeting, S.A.E., Hotel Statler, Cleveland.
Sept. 11-13	Third Annual Air Races, Sioux Falls, S. D.
Sept. 12	Schneider Trophy Contest over Solent and Spithead.
Sept. 12-13	International Air Fete, Los Angeles.

Schneider preparations

Great Britain's superior position in aircraft speed may continue uncontested this year, for while British preparations for the Schneider Trophy race are being rushed, French and Italian plans are proceeding more slowly. The British designer, R. J. Mitchell, of the Supermarine Company, is following in general the model of the 1929 entries, modifying the size of floats to accommodate the larger fuel supply necessary. The navigability trials this year are to be made just before the race itself, without refueling. The Rolls-Royce engineers have been working on plans for increasing cooling to permit greater engine power than was possible in the past, and 2,300 hp. is a reported possibility.

The French engineers of the Lorraine and Renault companies are also aiming at well over 2,000 hp., the first named company concentrating on a twelve-cylinder inverted engine which will weigh but 1,270 lb., or about .575 lb. per hp. It is understood that the planes are to be of about the same design and dimensions as those produced but not used in 1929, but their completion in time for the race on Sept. 12 is not assured.

The timely fulfillment of the Italian plans is also a matter of doubt. A new Fiat is being developed, eighteen cylinder and water-cooled, which will

produce 2,300 hp., but weigh several hundred pounds more than the Lorraine product.

The chief aeronautical event of the year for Italy is the flying tour, Giro Aereo d'Italia, which started from Rome on July 10. It is limited, with a few exceptions, to planes of less than 880 lb. empty weight, and will cover 3,530 miles in six stages on alternate days. Various technical trials the week preceding the tour determined handicaps for the contest. Points were awarded on the basis of an altitude test, take-off and landing tests, piston displacement, and wing loading, as well as a comprehensive rating of "touring qualities," which includes the provision of fire extinguishers, parachutes, brakes and starting systems and facilities contributing to the comfort of pilot and passengers.

The first lap of the tour was marred by a crash in which three participants were killed, and four other planes were forced down.

Airway on trial

In this country, extensions and improvements on scheduled airways are the order of the day. The northern transcontinental airway, Seattle to St. Paul, is up again. Using a special $20,000 appropriation provided for this express purpose, the Airways Division of the Department of Commerce is making a survey of the proposed route to determine whether or not it would be economically justified. The survey will not include actual selection of intermediate fields or sites for lights, but will involve study of the terrain to estimate airway installation costs.

Col. Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, has hinted that it is extremely doubtful if the airway would be economically justifiable. He cites the record of Mamer Air Transport, which during four and one-half months of 1930 operated between Seattle and St. Paul. Only 325 passengers and 900 lb. of express were carried in that period. The airline distance between the two terminals is about 1,400 miles. Representatives of the Northwest, especially Senator Dill of Washington, have been campaigning for the airway and secured the survey appropriation.

Lighting of the Paris-London airway has been practically completed. The majority of the lights are electric, the balance gas. Radio apparatus has been bought for the Cairo-Cape Town Airway installation.

Post Office Department makes hay

The air mail map is being filled in further. Sixteen extensions to existing air mail routes are to be made during July and August, bringing the total number of miles flown by mail planes daily to about 100,000. Some of the extensions, like that from Boston up through Maine or from Omaha up through South Dakota, are feeders to a single existing route, but in a larger number of instances they serve as cross-links to tie two or more routes together. After the new lines are opened there will be four complete north-to-south connections binding the three existing transcontinental services together at various points along their length.

Eleven of the sixteen additions are literally new or extended routes. The other five represent additional schedules over existing lines. Five of the new routes go to American Airways (Aviation Corporation), to wit: St. Louis to Memphis, Forth Worth to Amarillo, Boston to Bangor via Portland, Boston to Albany, and Air Express gets new cross-connections between Pueblo and Amarillo and Pueblo and Albuquerque. Boeing Air Transport will operate the feeder line between Omaha and Watertown, S. D. Atlantic City is to acquire a sudden glut of air mail services when Eastern Air Transport opens operations on three short routes between that city and Philadelphia, Washington and New York. Eastern Air Transport recently acquired control of New York Airways, Inc., a subsidiary of Pan American Airways, which previously operated a passenger service over the last named route. The five existing routes on which service will be increased in frequency are New York-Kansas City (Transcontinental & Western Air), Cheyenne-Denver (Western Air Express), Cleveland-Nashville, Albany-New York and Albany - Cleveland (American Airways).

The Boston-Bangor route, contracted by American Airways, is sub-let to Pan American Airways, which is to run a Boston-Bangor-Halifax service in close cooperation with the Boston & Maine and Maine Central railroads. The Postmaster General has announced the opening of bids for a one-way extension of this route, to Halifax, N. S., giving an additional connection with Canadian airways. For the present the Bangor-Halifax section will carry passengers only. Planes used on the New York-Atlantic City run of New York Airways are available as equipment for the new route.

The award of these contracts occasioned a great deal of surprise, as a number of the routes covered had not been the subject of any previous public mention by Post Office Department officials and it had been anticipated from testimony before Congressional committees and from other published declarations that only about six new lines would be started within the next year. The new awards were made just before the end of the fiscal year. On July 1 there became effective a new limitation on the initiative of the Postmaster General, as the Watres Act provides that after that date there shall be no inauguration of new services which lack Congressional authorization, or which cannot be operated without incurring a deficit in the existing appropriation. Until this time the Postmaster General has had an unusual measure of discretion, which occasioned some suspicion and criticism in Congress during last winter's session. A special Congressional committee is now preparing to inquire into the whole subject. The new contracts have been the subject of some attacks by representatives of companies already operating with passengers only over some of the routes covered by the new awards or routes closely paralleled thereto. There have, however, been no formal protests.

FINIS

The Winnie Mae at Roosvelt Field and part of the huge crowd which witnessed the conclusion of the venture

RECORD OF THE POST-GATTY FLIGHT

	Miles	Flying time Hr.	Flying time Min.	Average speed	Total flying time from N. Y. Hr.	Total flying time from N. Y. Min.	Total Elapsed time Hr.	Total Elapsed time Min.
New York to Harbor Grace....	1,132	6	52	165	6	52	6	52
Harbor Grace to Chester.....	2,195	16	17	136	23	9	26	49
Chester to Hanover.....	534	3	40	146	26	49	31	49
Hanover to Berlin.....	154	1	15	123	28	4	34	34
Berlin to Moscow.....	991	8	52	112	36	56	54	34
Moscow to Novo-Sibirsk.....	1,579	10	32	150	47	28	76	36
Novo-Sibirsk to Irkutsk.....	1,055	6	10	171	53	38	91	59
Irkutsk to Blagovestchensk....	1,009	4	50	208	58	28	99	4
Blagovestchensk to Khabarovsk	361	4	..	90	62	28	117	34
Khabarovsk to Solomon Beach.	2,500	16	45	149	79	13	160	49
Solomon Beach to Fairbanks...	520	3	55	133	83	8	166	29
Fairbanks to Edmonton.....	1,450	10	15	141	93	23	182	43
Edmonton to Cleveland.....	1,600	10	36	151	103	59	204	19
Cleveland to New York.....	394	3	3	128	107	2	207	51
Total distance.....	15,474	107	2	146	...	..	207	51

Another trans-Atlantic airway suggested

Following the lead of English and German interests, the United States is officially considering the possibilities of a trans-Atlantic airway via Canada, Greenland, and Iceland. The Post Office Department is studying the route and it is possible that the British and German geological expeditions will be supplemented by one from this country.

The latest development in the controversy over the United States terminal of the proposed air mail service to Bermuda is a statement by Postmaster General Brown that Charleston, previously officially declared to have been definitely chosen as the U. S. terminal, had only been tentatively named. Immediate action on trans-Atlantic air mail seems unlikely in any event. The invitation to bid for a Boston-Halifax mail route suggests renewed consideration of a northern trans-Atlantic route.

American Airways is speeding up its New Orleans-Atlanta service by purchase of seven Stearman mailplanes, equipped with 300 hp. Wright engines and having a payload of about 750 lb. Schedules, yet to be approved by the Post Office Department, will decrease the time by one hour. On June 15 the mail plane from the North German Lloyd liner Bremen landed in New York Harbor about fifteen hours ahead of the liner, landing the day before the ship for the first time this year. The plane left the ship 500 miles at sea.

Passenger traffic has been heavy during the late spring and early summer on practically all lines. Many runs are being operated at capacity, especially on week-ends and extra sections are becoming more and more frequent,

Western Air Express reports that in the first five months of this year 499 persons were flown over its San Diego-Los Angeles-Salt Lake City airway, as compared with 91 during the same period in 1930. During May, American Airways planes were flown 585,666 miles and carried 3,144 revenue passengers. Pan-American Airways carried 335 passengers between Miami and Havana, and 34 between Havana and the Canal Zone.

Harris M. Hanshue has resigned his position as president of Transcontinental & Western Air, Inc. to devote all his time to the financial affairs of Western Air Express, of which he also is president. Western Air Express, in which General Motors is largely interested, through its affiliated company General Aviation, recently passed its quarterly dividend of 15 cents a share, which it has been paying since May 1929.

During June, Century Air Lines handled 6,206 paying passengers, 1,035 of them on the St. Louis-Chicago section.

Passenger and express rates drop

Reductions in fares continue. United Air Lines, following the reductions announced last month for National Air Transport and Pacific Air Transport, reduced passenger fares on all other divisions on July 1 between 10 and 20 per cent. On that date, also, a system of "common point" rates, more familiar in railroad rate practice, was inaugurated. Fares to eastern points from six of the important Pacific Coast cities will henceforth be identical. For instance, the passenger rate to New York from Los Angeles, San Francisco, Portland, Tacoma and Seattle and Spokane is to be $200. Formerly it ranged from $215 to $245, depending upon the point of origin. The charge from these points to Cleveland is now $169.25, to Chicago $150. Northwest Airways, operating between Chicago and the twin cities and Winnipeg, has cut rates 20 per cent.

Most startling rate revisions of July, however, have been on the Pacific Coast, where the opening of operations by Century Pacific Air Lines has started a rate war. Century Pacific operating under Cord management, opened its San Francisco-Los Angeles and Los Angeles-San Diego services on July 5, with the Los Angeles-San Francisco fare set at $18.95, $3 below the rail-plus-pullman charge and only $2 above the day coach rate. A further 10 per cent reduction is made on round trip tickets. Pacific Air Transport, and Transcontinental & Western Air, promptly cut their rates to match those of the Century Line and staggered their schedules to reduce competition with each other and concentrate on the newcomer. Century is running six round trips daily between Los Angeles and San Francisco, averaging departures at two-hour intervals, and the two other companies combined have four round trips daily.

Competition and capacity loads

Result of the rate reductions and of new activity in advertising and in traffic solicitation has been an unprecedented growth in the volume of travel. All lines

NEW MAIL ROUTES

The air mail map of the United States modified to date. The heavy lines show the new extensions

report full loads as a regular rule. On the Los Angeles-San Diego service, where the rates have also been cut to below the train fare, with hourly departures, the Century Line carried 265 passengers in the first three days, 74 per cent of full capacity of the planes. Century is using Grand Central Air Terminal at Los Angeles, and both Mills Field and Oakland Municipal Airport in the San Francisco district. Stops are made at Fresno and Bakersfield.

To meet high frequency competition from Century Air Lines, the Universal Division of American Airways began on June 18 new schedules with lower rates on the Chicago-Springfield-St. Louis run. Four trips are made daily each way, and special round-trip tickets are being emphasized. The Chicago-St. Louis round trip excursion ticket, good for a five-day period, costs $18.50. Century gets $25.11 for its regular round trip ticket. Universal formerly operated three passenger planes daily between these points.

Officials of Railway Express Agency met early in July with representatives of airlines with which it has air express contracts for consideration of proposals to lower its present air express rates of $0.65 per ¼ lb. No action was taken, but further conference was arranged for the near future.

Air parcel post is now carried from Britain to India by Imperial Airwavs at the rate of $1.50 per lb.

New fast services for the West

Midland Air Express began operating a daily Kansas City-Cheyenne passenger service on June 8. Bowen Airlines has extended its service from Fort Worth to San Antonio with two trips per day. Chicago-Detroit Airways has installed a 99-min. service between the two cities by Lockheed Vega. Transcontinental & Western Air is to move its general offices, operating headquarters, and overhaul base to Kansas City (Mo.) Municipal Airport.

Passenger service between Los Angeles and Reno has been resumed with Gilpin Air Lines as the operator and Bach trimotors as the equipment.

Canadian Airways, the national company backed by Canadian Pacific Railway, plans important transport developments in British Columbia. Opening wedge is a twice-daily service by Boeing flying boats between Vancouver and Victoria.

Oriental airway news, good and bad

Inter-Island Airways, which has been operating a passenger service among the Hawaiian Islands for eighteen months, has added another Sikorsky S-38 to the fleet of three with which it started business. A re-designed Boeing single-engined Monorail type is receiving further service tests on the Oakland-Chicago run.

Installation of an airline across India has hit another snag. A press report from Simla states that no further expenditures on civil aviation will be made by the Indian government. The Avro Tens (Fokker-designed, built under license by Avro) ordered will be accepted but, as there will be no funds for maintaining weather service, the proposed airline operation is extremely doubtful. Even the Karachi-Calcutta service, more than a year active, may have to be suspended. This was to have been a part of the proposed Imperial Airways line to Australia.

The peaceful penetration into Asia of the Junkers airlines continues, with a 40-year contract said to have been secured from the Afghan government to establish a line from Herat to Kabul, Afghanistan. As soon as conditions within the region permit, service will be commenced, connecting at Herat with the Teheran-Meshed Persian service to Europe. Junkers already has a monopoly in Persia.

The Eurasian Aviation Corporation organized by the Ministry of Communications and the Deutsche Luft Hansa, used four Junkers planes on its Shanghai-Manchuli mail service, inaugurated late in May. From Manchuli the mail goes by train to Irkutsk where it connects with the airline to Moscow and Berlin, giving a bi-weekly service direct to Europe from Shanghai.

Failure to secure government subsidy has caused Australian National Airways, operated by Charles Kingsford-Smith, conqueror of sundry oceans, to suspend its Sydney-Brisbane and Sydney-Melbourne services.

The financial report of the Deutsche Luft Hansa for 1930 shows cash, acceptances and bank credits making up $683,257 of assets totalling about $3,100,000, while the value of airplanes and engines on hand is listed as $2,220,000. The gross income for the year was $5,820,000.

The first of the Handley Page Type 42 transports, better known as the Hannibal, was flown regularly on the London-Paris service of Imperial Airways during June, carrying freight only. About July 1, the machine was put on the regular passenger and mail services. Seven other Hannibals are in various stages of construction.

A NEW DISTANCE RECORD

The Dewoitine Trait d' Union used by Joseph Lebrix and Marcel Doret to establish a new closed circuit distance record.

Airways buy new planes

Delivery of a Short Calcutta flying boat was recently taken by Capt. Dieudonne Costes and an Air Union pilot, at Rochester, for the French transport company, the Air Union. An agreement between the Short and Breguet companies provides for the future manufacture of these planes in France under license, and work on an order from the French government has already been started at the Breguet factory.

Airway traffic control

Twenty-three subcommittees have been appointed by the Department of Commerce committee on air traffic control to study traffic at 23 airports throughout the country. Committees have been appointed at Los Angeles, Oakland, San Francisco, Hartford, Miami, Chicago, Baltimore, Boston, Detroit, Minneapolis, St. Paul, Kansas City, St. Louis, Camden, Newark, Columbus, Cleveland, Pittsburgh, Nashville, Dallas, Fort Worth, Seattle and Washington.

The studies are to determine time spent by approaching planes in the vicinity of the airport getting ready to land, time spent on the ground approaching the loading platform or waiting an opportunity to take off, the extent and character of mechanical signals necessary to govern traffic.

Paralleling this study is the work of a subcommittee of the Aeronautical Chamber of Commerce, commissioned at the third National Airport Conference in March to investigate traffic control signals. A preliminary report suggests consideration by the entire Airport Section of the Chamber of a visual system for approaching planes

which has been developed at the Newark airport. [Described in detail in the Airport Management department, page 494.]

Airport ratings change

Field representatives of the Airport Section of the Department of Commerce have been touring twelve states—Michigan, Wisconsin, Minnesota, North and South Dakota, Nebraska, Kansas, Iowa, Missouri, Illinois, Indiana and Ohio—inspecting airports for federal rating. Their work has not yet shown itself in any rush of new A1A ratings.

Moving the federal weather bureau station from Bolling Field to the Washington-Hoover airport, serving the District of Columbia, may mean either settlement or an anticipated indefinite prolongation of the long-drawn-out controversy over the location of the capital's municipal field. The transfer was made early in July.

Detroit City Airport has been designated as an airport of entry for one year. Effective June 30, the following four were discontinued as airports of entry: Grand Central Air Terminal, Glendale; Western Air Express Airport at Alhambra, Ryan Flying Field, San Diego, and the Encambron Field at San Juan, Porto Rico. The eliminations represent the general tendency to economize and serve the convenience of passengers by concentrating transport operations at a single field in each city. Lindbergh Field at San Diego, United-Burbank airport at Los Angeles, will henceforth serve international traffic.

New houses, new hangars

Architects have been selected for the $250,000 housing unit for the 101st Observation Squadron, 26th Division, National Guard, at the Boston Municipal Airport, and construction work probably will start in August. The City of Boston has been given authority by the legislature to borrow $1,250,000 outside the debt limit for development of the municipal airport. When that is spent the field will represent a total government outlay, including the cost of the original fill, of some $5,000,000.

Work is proceeding rapidly on a large hangar, to be completed in August, for Century Air Lines at the Chicago Municipal Airport. The $100,000 hangar and office building for National Air Transport at Kansas City Airport, Mo., is also to be ready for occupancy in August. The new $70,000 administration building at Tulsa is to be finished by Nov. 1. Engineering work on the Shushan Municipal Airport for New Orleans will be done by the National Airport Engineering Company, Los Angeles.

Tours take to the air

Summer being the open season for air tours, many are scheduled in this country. Local tours were flown late in June in Indiana and Iowa. The Aviation Country Club of Long Island held a spring meet and also a four-day Air Cruise, non-Competitive, with twenty seaplanes participating, the most important and successful event ever run for private owner-pilots in America.

Of greatest interest, however, is the National Air Tour which started from Detroit on July 4. Fourteen planes took off on a 6,000-mile flight which will take them as far south as Corpus Christi, Tex., in competition for the Ford Reliability Trophy. As AVIATION goes to press, Harry L. Russell, who won the trophy last year, leads in a tri-engined Ford. The field has been reduced to nine planes, five entrants having been forced down by engine trouble and difficulties encountered in landing and taking off from fields in mountainous regions.

More than 2,000 miles in Oregon, Idaho, California, and Washington were covered by Northwest Air Tour, flown between June 27 and July 7. Fourteen stops were made by the tour fleet, which numbered over 50 participating and spectator planes.

Plans and planes for national competitions

Elmira, New York, will be the scene of the 1931 National Soaring Contest, to be held August 2-16 inclusive. The Edward S. Evans Trophy, now held by Albert Hastings, will be awarded for the largest number of points in the duration, straight-line distance, and altitude events, and other contests are planned, including greatest aggregate time in the air between any dawn and dusk, spot landings, and an illustrated thesis on the science of soaring.

The National Air Races, to be held in Cleveland Aug. 29 to Sept. 7, will have among the contestants Flight Comdr. Richard L. E. Atcherley, member of the British Schneider Cup team of 1929. A new speed plane designed by Major James H. Doolittle to replace his ship which won second place in the National Races last year was destroyed during its initial speed tests. Failure of the wing covering at a speed of about 235 m.p.h. forced Doolittle to leap to safety. Participation of Army and Navy planes in the races this year will be limited to demonstrations of tactical maneuvers, none being permitted to race either in competition with each other or civilian planes.

Both the War and Navy Departments, however, are sending entrants to the National Balloon Race at Akron on July 18. The race this year will be contested by six balloons, each with a capacity of 80,000 cu.ft. and inflated with neutral gas, the winner to receive the Litchfield Trophy and a place on the team representing the United States in the annual International Gordon Bennett balloon contest, for which two other members will also be chosen from contestants who secure high place.

Simple alterations in the form of waterproof shields on its bumpers have made it possible for the Graf Zeppelin to come down without the aid of a land or water crew, a successful landing on the waters of Lake Constance demonstrating the practicability of the new equipment.

Earlier Zeppelins, with gondolas of different construction, regularly used the lake as a landing place, and were housed in floating hangars moored along the shore.

Another device to make Arctic exploration safe for the Graf Zeppelin is provided by Prof. Paul Maltschanof of the Technical University of Aviation at Leningrad. He has developed a compact apparatus which when attached to a small balloon and released from the Zeppelin will automatically radio back to its cabin reports on temperature and air pressure encountered up to a range of 120 miles.

Thus equipped the Graf inaugurated a heavy summer program. On June 30 it took off for a cruise to Iceland, Norway and the Polar Zone with twelve passengers, including Lt. Comdr. E. H. Smith of the U. S. Coast Guard. A trip partly sponsored by the Soviet Union for Civil Aviation will next be made to the Arctic from Leningrad by way of Archangel, to photograph and explore islands and investigate atmospheric conditions in the region beyond Franz Josef Land. In addition to its Arctic voyages, the Graf had planned a 24-hour excursion around Great Britain, late in July, chartered by the Flying Club of Hanworth, to carry twenty of its members but the political situation in Germany forced cancellation of the flight. Two trips to Brazil are also projected.

A tentative date has been issued for the launching of the Navy's new rigid airship Akron. It is to be air-borne for the first time on Aug. 8, and shortly afterward will make a series of trial flights under the supervision of a naval board as a basis for its acceptance by the Navy Department.

Completed and contemplated Navy plans

The completion of the Navy's five-year aircraft program in four years, frequently heralded during the last few months, with the delivery of the 1,000th plane on July 1 became an actual fact. The outlay of $62,000,000, 23 million less than authorized, gives the Navy a force two-thirds of which is ready for immediate operation, the remainder, including various types of training planes, being held in reserve.

A new five-year plan for the air services, to sustain and continue the development made by the one just completed, has been suggested to President Hoover by Senator Bingham as essential for the future both of the services and the aeronautical industry.

Assistant Secretary Ingalls, however, has offered his opinion that the Navy is so well situated at present that a new procurement program is unnecessary, and that a general authorization to keep all naval vessels equipped with their full complement of planes will be preferable.

Navy in the market

Though a few days previously it had been announced that the purchase of 135 planes would be postponed, partly because of an economy program, but also to await the results of further trials of experimental patrol boat models, the Navy Department opened bids on a group of patrol boats and aircraft engines late in June. For the patrol planes some manufacturers offered alternative bids on two designs, the lower of the Glenn L. Martin bids—$1,354,186.94—giving a unit price of about $47,000 per plane without spares, the lowest figure received. The next bid by Douglas Aircraft Company, was $1,437,700 for 23 planes, approximately $50,000 each. The lowest bid offered for 69 engines and their spares was $492,550 by the E. W. Bliss Company, who supply engines of Bristol-Jupitor design, at a unit cost of about $5,710 without spares. This is the first bid for a large quantity of engines of the British Bristol design submitted to the service by the American licensee in competition with all-American manufacturers. One of two bids by Wright Aeronautical Corporation was next lowest with $523,506.85, a price of $6,100 for each of its Cyclone engines. Pratt & Whitney asked $538,179.98, or $6,200 for each Hornet engine.

The award of a contract to Curtiss Aeroplane & Motor Company by the Navy Department for 30 Helldiver planes at $443,235.75 has also been announced, — about $11,840 for each two-seater observation machine without spares.

The Navy Department has awarded a contract for two autogiros to the Pitcairn Aircraft Company,—total price, $44,076. They will be tested for their possibilities as naval observation planes.

Autogiro achievements

Public attention has been attracted to the trip which Miss Amelia Earhart has just made across the continent and back in an autogiro. She flew 11,000 miles in slightly more than 150 hours, the chief difficulty being small fuel capacity, which made frequent landings necessary. The planes flown by Miss Earhart are among the 22 autogiros licensed or identified by the Department of Commerce up to July 1.

The R.A.F. parades

At the annual Royal Air Force pageant at Hendon the advance recently made in speed and maneuverability of British aircraft was strikingly displayed. The Hawker Fury, a single-seater fighter without peer in the matter of speed among the air forces of the world, equipped with a 500 hp. Rolls-Royce engine, claims 214 m.p.h. at the high altitudes for which its supercharger especially fits it. Exhibition and formation flying displayed the ease and precision with which these planes and also heavier models such as the Hawker Hart bomber may be handled. Machines interesting for their size or design novelty were the Vickers bomber with its four Rolls-Royce Kestrel engines and a new tailless Pterodactyl, designed and built as a commercial airplane, not merely as a laboratory novelty.

New engines

Experimentation with heavy oil engines, which has been going on cautiously in England for a long time, begins to show results. A "dieselized" Rolls-Royce engine has been developed, capable of 650-700 hp. and weighing 1,430 lb., giving a ratio of about 2.12 lb. per hp. as compared with 2.50 lb. per hp. in the Junkers and Packard engine.

Tests of the Junkers heavy-oil engine Jumo 4 made recently at Adlershof give its weight as 2.42 lb. per hp. Fuel consumption during the trials was .37 lb. fuel oil and .03 lb. lubricating oil per horsepower-hour.

Another method of aircraft propulsion continues the subject of research. Dr. Robert H. Goddard, of Worcester, Mass., who has been working with high-flying rockets for more than ten years, since 1928 with a grant from the Guggenheim Fund, proposes now to use their high-velocity gases to drive a turbine, which in turn drives an aircraft propeller, at low altitudes. The same gases drive the aircraft directly by pure "rocket" or jet action in high altitudes where the propeller is useless.

Aeronautical independence in sight in U.S.S.R.

A semi-official report from the U.S.S.R. indicates that technical advances there will soon enable them to be independent of the foreign engines which up to now have propelled almost all their aircraft. Engines of 300 and 450 hp. have especially occupied Russian designers, of whom Kalinin has been most mentioned. Five of the more powerful of these engines are being used in a 32-passenger plane which, if successful in tests, will be produced in quantity to equip all airlines in the Soviet.

Corporation developments

A new organization in the aeronautical world is the British Aviation Insurance Company, Ltd., formed in London to take over and extend the work of the British Aviation Insurance Group, organized in 1924. The capital of $1,250,000 in $5 shares has been subscribed and paid up by numerous well-known insurance companies, which, through their agencies in every part of the world, will be able to offer aeronautical insurance on a wide scale to meet a rapidly increasing demand.

Herbert V. Thaden has been appointed acting chief engineer and general manager of Fokker Aircraft Company. Albert A. Gassner, former chief engineer, has resigned, together with a number of his associates. Mr. Thaden was founder and lately the general manager of the Pittsburgh Metal Aircraft Corporation, recently acquired by General Aviation, of which the Fokker company is also a subsidiary.

Close upon the heels of the announcement of his resignation as chief engineer of General Aviation came Anthony Fokker's plans for the extension of his own manufacturing interests in an International Fokker Corporation built around the nucleus of his Dutch company. With the completion of government orders now under construction, licensing agreements with General Aviation will be cancelled and the rights of his name returned to Fokker, leaving him free to carry out his plans for the new company which will have its headquarters in this country.

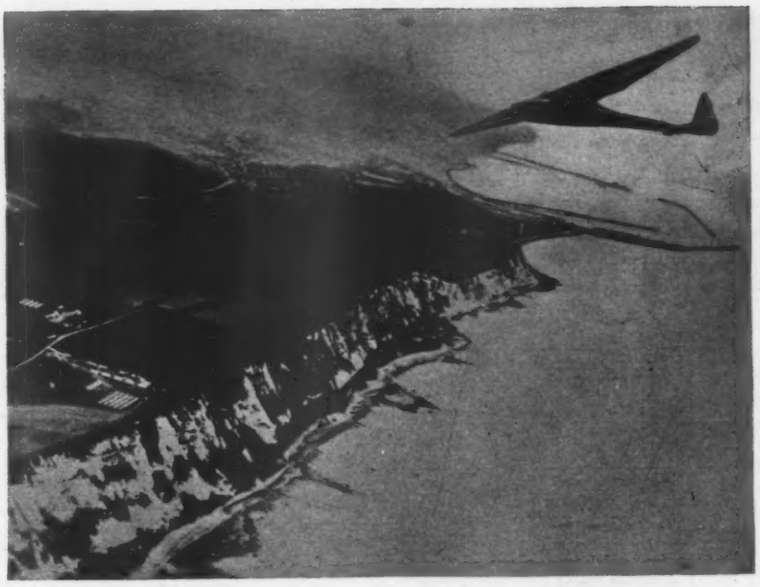
The fate of the New Standard Aircraft Corporation, pending for several months, was finally settled with the authorization by the Chancery Court in Paterson of negotiations for its merging with Farman Aircraft Corporation to form the Farman - Standard Aircraft Corporation. The new owners allot 10,000 shares each of common and preferred stock to the receiver against liabilities and preferred claims, and assume administration expenses, wage claims and mortgages held by the Standard company.

The future of the Mono Aircraft Corporation is still a matter of conjecture. Negotiations relative to the possible assumption of control by interests in St. Louis are still going on, but no agreements have been made.

Important legal decisions

The material immediately following, together with references to legal and legislative matters elsewhere in the news pages, is based largely upon the Aviation Law Service prepared by the Commerce Clearing House, Inc. AVIATION is licensed to make use of this service, and is able to give its readers the benefits of the work of an organization specially trained and equipped to insure the complete collection of pertinent material on current legal developments.

Several judicial decisions have been made recently which influence legal opinions, still in the formative stage as concerned with aeronautics. When the doctrine that certain things are axiomatic on their face and need no further



OVER THE DOVER CLIFFS

Kronfeld at the conclusion of his glide from the English side of the English channel to the French side and glide back.

proof, known to lawyers as *res ipsa loquitur,* was submitted in the Boston Municipal Court as basis for the claim that the engine of a Colonial Transport plane could not have stopped shortly after leaving the airport except as a result of negligence on the part of the company, the court ruled the argument unsound. In a case brought to the U. S. District Court of Wyoming, claiming the exemption of an interstate transport line from the state gasoline tax on the grounds that its operations within the state were only incidental, the ruling was that the imposition of the tax was valid, since there was no discrimination made against the company in levying it, and the tax receipts were used to provide airport and airway facilities enjoyed by the transport operator.

A case upon which seemed to hang the establishment of a precedent to fix the legal responsibility of air transport companies, and the determination of their ability to escape common-carrier status by having each passenger sign a ticket in the form of a contract, was brought against Transcontinental Air Transport by Mrs. J. P. Law in the U. S. District Court at Philadelphia. She claimed $150,000 compensation for the death of her husband as a result of a T.A.T. plane crash at Indianapolis in December, 1929. However, the case was settled out of court for $5,000, and the legal issue remains uncertain as before.

The Chamber organizes its legal activities

To present a common front for the aviation industry in dealing with its legal and legislative problems, the Aeronautical Chamber of Commerce has reconstituted and strengthened its legal and legislative committee. The scope of the committee's work is extensive, covering both the broad fundamentals of air law and such questions of detail as gasoline taxation. It plans close cooperation with the American Academy of Air Law and the air law committee of the American Bar Association. The legislative policy in general will be to urge as little legislation as possible.

The state legislatures

Legislation of a rather unusual order has been enacted by Florida and Michigan in regard to airports and landing fields. Florida has authorized the State Road Department to establish emergency landing fields along highways, and extended the powers of individual counties to enable them to acquire the necessary land, though the expenditures of the Road Department for the purpose are limited to $20,000 in any one year. The Board of Aeronautics of Michigan is now authorized to require the marking of all obstructions within hazardous distance of all approved airports. The erection of new telephone, high-tension, or other lines or poles within 1,000 ft. of an airport is expressly forbidden by the new statutes, but in the case of obstructions already existing the marking is to be done at the expense of the airport operator. The only legal obligations placed on the owner of the obstruction are that he must permit free access to it for the purpose of marking, and he must raise no objection to a change of its color scheme.

Oklahoma and New York have joined the ranks of states requiring licenses from the Department of Commerce for all aircraft and pilots operating within the state. The New York Legislature has also moved to forbid the towing of gliders except with Department of Commerce permission, and to restrict parachute jumping for exhibition and test purposes. Planes carrying passengers for hire in the state are required to adhere strictly to air traffic regulations, including the ruling made by the Department of Commerce more than a year ago that a transport plane must land immediately when a low ceiling forces it below 500 ft. altitude.

Department of Commerce announcements

Efforts of the Department of Commerce to protect not only the safety of airplane pilots and passengers, but also the safety and comfort of the population over which they fly, are evident in action taken recently by the Aeronautics Branch. Pilots are warned of precautions which they must take when parachute exhibition jumps are made from their planes to ascertain the training and experience of the jumper and to prevent his hopping off over any congested area or established airport. Disciplinary action has been taken against five pilots who caused disturbance at the Harding Memorial ceremonies at Marion and flew too low over the crowds assembled there to be consistent with public safety.

Twenty of the 36 Fokker planes withdrawn from scheduled passenger service early in May have been reconditioned by their owners, pronounced airworthy and returned to service. The wing coverings were opened for inspection, replacements and reinforcements of parts of the interior made where necessary, and the planes now satisfy the Department's requirements fully.

Personnel

Thomas A. Morgan, president of North American Aviation, Inc., has been elected president of the Curtiss-Wright Corporation.

Randolph F. Hall, formerly of the Thomas-Morse Aircraft Corporation, and until recently chief engineer of the Cunningham-Hall Aircraft Corporation, Rochester, N. Y., has resigned from that company.

J. B. Johnson, chief of the Materials Branch, at Wright Field, is to be a member of next year's Executive Committee of the American Society for Testing Materials.

Squadron Leader J. H. Tudhope, Superintendent of Airways of the Canadian Department of National Defense, has resigned to become chief pilot for the new British Columbia Coastal Airways, Limited.

Statistics of the Month

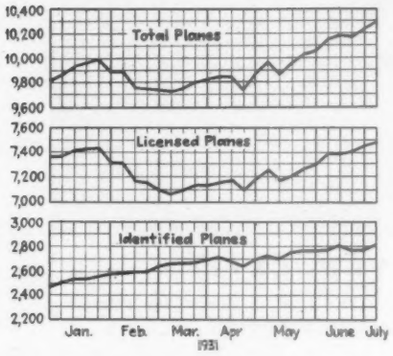
Material supplementing the statistical issue, AVIATION, March, 1931, appears regularly each month. Page numbers in the statistical issue are given.

PRODUCTION AND LICENSING

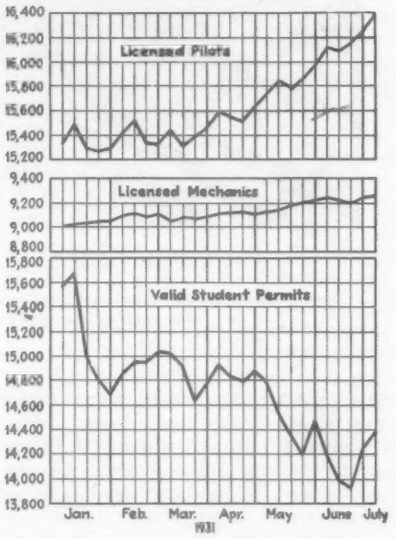
(Page 136)

A REPORT of aircraft production in the United States during 1930 completed recently by the Aeronautics Branch of the Department of Commerce shows a total of 3,437 airplanes with spares valued at $34,545,728. This is 753 more than given in a report of the Aeronautical Chamber of Commerce issued early this year, the discrepancy being due to planes of amateur and experimental construction not reported to the Chamber. The valuation is exclusive of engines, 4,356 of which were manufactured during the year, worth $17,267,793, with additional parts bringing the total engine value up to $22,396,054. Aircraft equipment, including pontoons, propellers, and parachutes, as well as lighter-than-air craft combine to make the aeronautical production of the year total at $61,211,197.

SINCE the latter part of May when it crossed the previously almost insurmountable 10,000 line, the curve for total number of planes legally approved for service has followed a consistently upward course, with only one slight setback the third week in June. Increasing at the rate of about 50 planes a week it had almost reached 10,300 at the end of the first week in July. The single decrease is traceable to a drop in identified planes in the last half of June, for the curve of licensed planes has moved steadily upward, with only one level stretch.

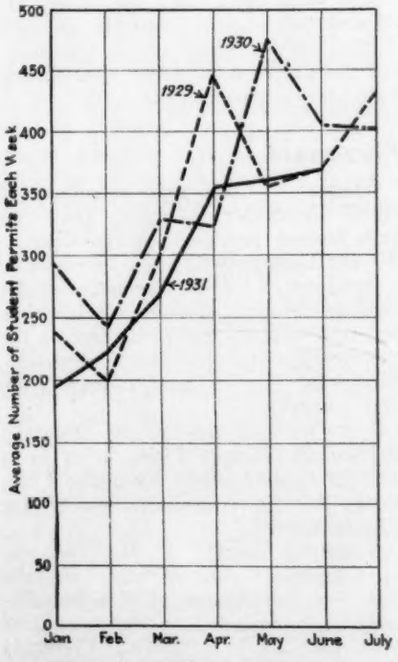


Valid airplane licenses and identifications

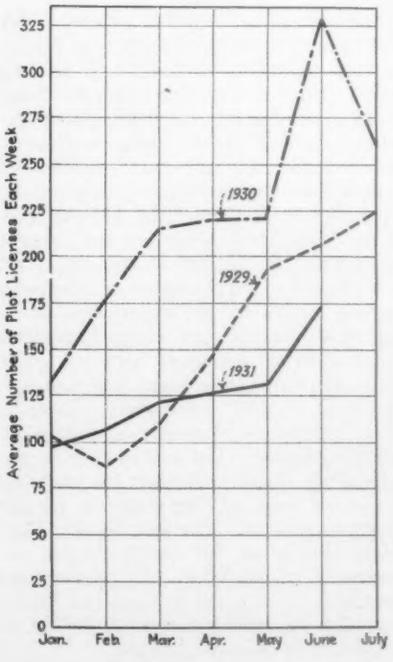


Valid pilot licenses, student permits in force and valid mechanics' licenses

THE upward tendency is equally evident in the curves for plane operators. The number of licensed pilots has been increasing at the rate of almost 100 a week, despite one small drop the second week in June, and has reached a point far in advance of any touched before. The curve for student permits, after dropping steadily since early in May, changed its course and at the end of the first week in July had regained half the ground lost. The curve for licensed mechanics, though on the upturn at present, shows no more activity than usual, maintaining about the same level reached at this time last month.



Student permits newly issued, month by month



New pilots licensed month by month

THE curve showing the average weekly issuance of student permits during the spring of 1931 is directly in contrast to those of the two preceding years. There were sharp peaks in April and May of 1929 and 1930, but the present year shows a variation of only ten points in the average number of permits issued weekly between April and June, with an apparent stabilization at the rate of about 360 permits each week. The weekly issuance of pilot licenses, on the other hand, closely parallels that of the previous year, though the current averages are 40 to 48 per cent below those of 1930.

THE Aeronautical Chamber of Commerce report on production and sales

Makes of Newly Licensed and (Identified Aircraft)

Second quarter, 1931

	Licensed	Identified	Total
Aeronca	24	..	24
American Airplane & Engine (formerly Fairchild) all open biplanes	5	..	5
American Eagle:			
American Eagle	1	..	1
American Eaglet	7	..	8
Amphibions:			
Privateer	2	..	2
Five place	1	..	1
Bellanca:			
Skyrocket	..	3	3
Airbus	..	3	3
Bird	21	..	21
Buhl Bull Pup	66	2	68
Consolidated (Fleet)	7	..	7
Curtiss-Wright:			
Junior	142	2	144
Kingbird	2	..	2
Moth	1	..	1
Robin	2	..	2
Travel Air biplane	33	3	36
Detroit:			
Lockheed	7	..	7
Ryan	3	..	3
Driggs	3	..	3
Eaglerock biplane	1	7	8
Fairchild (new company)	..	3	3
Fokker (one engine)	..	1	1
Ford	9	..	9
Franklin 90	..	3	3
Kellett Autogiro	..	1	1
Mono Aircraft	12	..	12
Nicholas-Beazley	..	10	10
Pitcairn Autogiro	2	13	15
Savoia-Marchetti	2	..	2
Spartan	1	3	4
Stinson:			
Four place	42	1	43
Airliner	23	..	23
United:			
Boeing (one engine)	1	..	1
Boeing (two engine)	..	2	2
Northrop (two place)	1	..	1
Northrop (seven place)	2	..	2
Sikorsky (one engine)	1	1	2
Sikorsky (two engine)	1	..	1
Stearman	7	..	7
Verville (monoplane)	1	..	1
Waco:			
Open	42	1	43
Closed	4	..	4
Miscellaneous†	14	111	125
Total	493	171	664

†All makes having three or more planes licensed or identified are listed above.

Makes of Engines in Newly Licensed or Identified Aircraft

Second quarter, 1931

	Licensed	Identified	Total
Aeronca	24	..	24
American Cirrus	1	2	3
Anzani	..	8	8
Chevrolet	..	3	3
Continental	12	7	19
Fairchild	1	..	1
Ford	..	11	11
Genet	..	9	9
Heath	..	10	10
Heath-Henderson	..	12	12
Henderson	..	9	9
Hispano	1	3	4
Jacobs	1	2	3
Kinner	50	3	53
Lambert	7	3	10
Lambert Velie	2	3	5
Lawrance	..	3	3
LeBlond	..	6	6
LeRhone	..	4	4
Lycoming	62	..	62
Michigan Aero Rover	2	4	6
Menasco	3	..	3
OX5	7	10	17
OXX6	..	2	2
P. & W. Wasp	22	4	26
Wasp, Jr.	6	1	7
Hornet	2	2	4
Salmson	..	3	3
Szekely	215	9	224
Warner	34	7	41
Warner, Jr.	1	..	1
Wright (165)	4	3	7
(240)	9	1	10
(300)	12	9	21
(220)	0	4	4
Cyclone	..	4	4
Gipsy	15	..	15
Miscellaneous (outboard)	..	10	10
Total	493	171	664

Status of Aircraft, Pilots and Mechanics as of July 1, 1931

(Page 149)

Aircraft	10,235
Licensed	7,458
Unlicensed	2,777
Pilots	16,268
Transport	6,532
Limited commercial	1,741
Industrial	67
Private	7,928
Gliders	1,207
Glider pilots	238
Mechanics	9,222

Figures for pilots include 445 women pilots—34 Transport, 53 limited commercial, 2 industrial and 356 private.

for April and the first four months of 1931, based on data from 57 airplane manufacturers, 20 engine manufacturers, and 10 float producers, shows little change in value of total production when compared with the figures for last year. The value of aeronautical products, including aircraft and engines for both commercial and military purposes, is only 8 per cent below the 1930 figure, while the value of aircraft produced is slightly larger than that of the preceding year. This is due to military orders, which are more than twice their former value. Commercial production shows a decrease in unit, as well as total value, reflecting the tendency of manufacturers to emphasize their light open models. Figures for the individual months illustrate even more clearly this trend, the number of aircraft produced ranging from 10 to 50 per cent below 1930, while value of product is 25 to 65 per cent under the reports for the early months of last year.

When planes produced on military order are included, the total number any month this year is never more than 20 per cent below the corresponding figure for 1931. In January 1931, 145 airplanes were manufactured as against 163 in the same month of 1930. February figures were 172 this year and 218 last year, the largest percentage decrease recorded. Totals for March were 235 and 249, those for April 269 and 273 for 1931 and 1930 respectively.

Production of engines during the current year has been greater in number than last year every month, with the single exception of January, percentages of difference ranging from 12 to 40. One hundred and seventy-seven engines were turned out in the opening month this year, exactly half the 1930 production. However, in February 1931 the figure was 272 as compared with 242 the previous year, while in March this year 427 engines were produced, more than 40 per cent in excess of the 1930 figure of 306. April totals were 390 and 361 for 1930 and 1931.

Production this year has shown a steady increase in both number and value from month to month. Fifty-nine planes were produced in January, valued at $248,435, while 196 planes worth $834,692 is the April record. Delivery figures are evidence that no large stocks are being accumulated by manufacturers, for in no month this year has the excess of production over delivery been greater than nine planes, and in March the situation was reversed, nine more planes being delivered than produced.

Aircraft and Engine Production

First four months of 1930 and 1931

	1931 Units	1931 Value	1930 Units	1930 Value
Commercial	.....	$3,667,904	.....	$6,837,739
Airplanes	491	2,205,626	703	4,255,609
Engines	769	1,462,278	732	2,582,130
Military	.....	7,581,355	.....	5,372,110
Airplanes	330	4,461,140	197	2,196,350
Engines	597	3,120,215	531	3,175,760
Total	.....	$11,249,259	.....	$12,209,849
Airplanes	821	6,666,766	900	6,451,959
Engines	1,366	4,582,493	1,263	5,757,890

AIR MAIL AND TRANSPORT

(Page 153)

Contract Air Mail Totals, April

	1931	1930
Length of route (miles)	22,831	14,565
Miles scheduled	2,342,273	1,386,006
Miles flown	2,194,536	1,309,240
Per cent of scheduled mileage flown	94.0	94.0
Total weight of mail dispatched (pounds)	750,638	676,271
Amount paid to carriers	$1,581,023.69	$1,296,988.06
Compensation per mile flown	0.72	0.99

Contract Air Mail Totals, May

	1931	1930
Length of route (miles)	22,788	14,659
Miles scheduled	2,455,986	1,447,667
Miles flown	2,346,991	1,392,439
Per cent of scheduled mileage flown	96.0	96.0
Total weight of mails dispatched (pounds)	750,960	702,629
Amount paid to carriers	$1,658,695.19	$1,189,321.06
Compensation per mile flown	0.71	0.85

FOREIGN ACTIVITIES

(Page 173)

(Page 174) Annual airplane Mileage in air transport, 1930

Czechoslovakia	560,000
France	5,836,000
Roumania	48,000

(Page 175) Passenger traffic in passenger-miles, 1930

Czechoslovakia	1,300,000
France	9,300,000
Roumania	133,000

(Page 175) Express and mail traffic in ton-miles, 1930

France	820,000
Roumania	430,000

FOREIGN TRADE

(Page 168)

Aeronautical Exports for April, 1931

	1931	1930	Per cent change
Airplanes			
Number	8	18	—55.5
Dollars	99,448	288,603	—65.6
Engines			
Number	19	29	—34.5
Dollars	57,176	109,324	—47.6
Parts and accessories			
Dollars	156,180	134,234	+16.3
Total (dollars)	312,804	532,161	—41.2

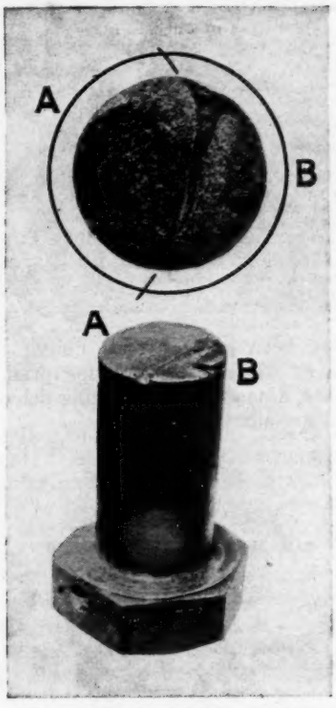


Fig. 1: Typical fatigue failure

Fatigue of aircraft

The first of two articles on its various

By
J. B. Johnson
Chief, Materials Branch
Materiel Division, Army Air Corps

THE failure of an airplane or engine part is seldom due to a single application of the load. This is guarded against by static tests on structures and block tests of experimental engines. Failures are generally due to a repetition of loads. In some cases the loads are sufficiently high to cause a yielding of the material which in ductile metals is accompanied by a reduction in area. In the majority of cases the stresses cause no apparent yielding and no reduction in the cross-section at the fracture. Failures of the latter type are called fatigue failures. They are not due to crystallization of the metal although some aeronautical engineers still explain them in this way and thus lose sight of the contributing causes for such failures which are very important. Failure is due to the growth of one or more cracks caused by localized high stress often due to flaws or minute cracks which were in the unstressed piece. Under the repetition of stress the crack spreads across the section until the specimen fails suddenly due to the high unit stress. A typical fatigue fracture is shown in Fig. 1. Area *A* appears smooth and shiny due to the rubbing together of the two parts, whereas Area *B* appears rough and crystalline, similar to that obtained by notching and breaking a bar by bending.

Fatigue machines

Repeated stresses may be tension or compression caused either by axial or flexural loads or shear due to torsional loads.

Several types of fatigue machines have been constructed in order to investigate the ability of metal to withstand these stresses. The machine in which the specimen is a rotating beam has been used more extensively than any other on account of its mechanical simplicity. The R. R. Moore machine used at Wright Field, was developed primarily for testing light alloys, although it is equally satisfactory for other metals. It is a plain bearing, rotating beam machine in which the specimen is loaded at two points equidistant from the supports. The machine is operated at a speed of from 1,700 to 3,500 r.p.m.

Table 1: Specimens from chrome-nickel crankshaft

	Tensile strength (lb. per sq.in.)	Yield point (lb. per sq.in.)	Elongation in 2 in. (per cent)	Reduction of area (per cent)	Fatigue limit (lb. per sq.in.)
Main bearing..	150,000	142,000	14.5	55	78,000
Cheek.....	159,000	142,000	15.0	55	84,000

In this type of machine the stresses are completely reversed each revolution and therefore the range is from tension to compression with a mean stress of zero. The maximum stress in the specimen is in the outermost fibers and is calculated from the beam formula $\frac{Pxc}{2I}$. This formula is used for stresses both within and above the elastic range, although not strictly accurate in the latter case.

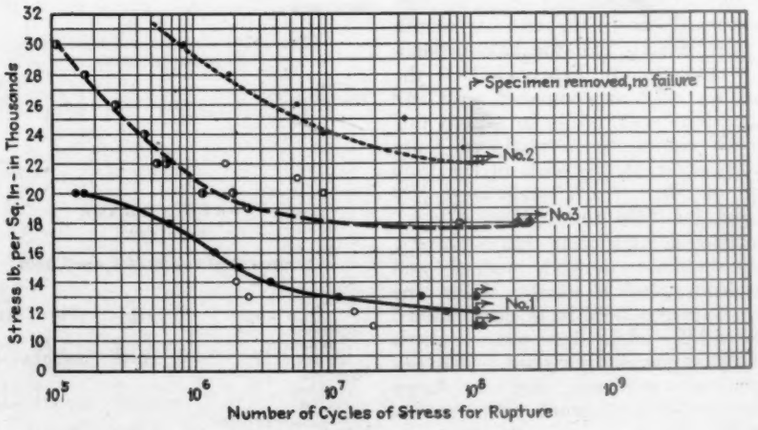


Fig. 2

Test specimen

The ends of the test specimen used in the R. R. Moore machine are tapered on the outside to fit the taper in the collets and threaded internally for the draw bar. The diameter is reduced at the middle in order to localize the fracture in this section. Since the surface fibers are subjected to the maximum stress, the finish on the surface will have an important effect on the results.

The specimen is ordinarily machined or ground and polished with No. 00 or No. 000 polishing paper or levigated

parts

characteristics

Fatigue fracture in propeller

alumina suspended in water. A polished specimen gives the most uniform and highest values for fatigue limit but determination of fatigue limits on specimens with the surface actually used in service is becoming of increasing importance. This is especially true of wire, tube and similar unmachined parts.

Fatigue characteristics of metal should be determined by testing a number of specimens using different intensities of stress. Data are plotted on log or semi-log paper. This is called an SN curve. In the semi-logarithmic diagram, Fig. 2, stresses are plotted as ordinates to a Cartesian scale and the number of cycles are abscissa to a logarithmic scale. The form of the SN curve will depend upon the kind of material. Ferrous metals generally have a fairly steep slope up to approximately 5,000,000 cycles. The curve then bends sharply and becomes horizontal. This stress is a graphical representation of the fatigue limit. Specimens at this stress are generally run from 10,000,000 to 25,000,000 cycles to insure that the fatigue limit has been obtained.

For some of the non-ferrous metals, such as duralumin, the change of slope is more gradual and no horizontal portion has been found up to 500,000,000 cycles.

The data on the relationship between the fatigue limit in reversed bending and direct tension-compression (axial loading) are conflicting. The Haigh machine is the most satisfactory type which has been developed for axial loading.

Table 2

Curve no.		Tensile strength (lb. per sq.in.)	Yield point (lb. per sq.in.)	Elongation in 2 in. (per cent)
1	Copper, annealed	33,900	10,900	56
2	Copper, strain hardened	63,400	61,000	4
3	Duralumin, heat treated[10]	69,400	40,600	17

The fatigue ranges found on this machine and reported by Gough[9] indicate that the ratio of the F.L. for direct tension-compression to F.L. for flexural tension-compression is not constant but may vary from 0.75 to 1.00 for different materials. Irwin[3], on the contrary, concludes that the ratio is always 1.00.

The fatigue limit in shear as determined under cycles of reversed torsional loading is lower than the tension-compression limit. H. F. Moore[1] recommends a value of about 55 per cent of the latter.

Characteristics of tests

Fatigue tests have demonstrated that the range of stress rather than the maximum stress determines the life of the material and that there is a limiting range for a given minimum and maximum stress. The maximum range of stress is obtained by a complete reversal from tension to compression. The maximum stress for relatively infinite life is lowest for this range and is termed the endurance or fatigue limit. The ratio of the minimum to the maximum stress for this cycle is —1, designating compression as a negative quantity. For ratio of —1 to 0 and from 0 to +1 the maximum stress for infinite life exceeds the conventional fatigue limit but the range of stress is less than in the case of complete reversal. Prof. H. F. Moore[1] recommends the following formula which has been found to fit the empirical data:

$$S_{max} = \frac{3\,S_{-1}}{2 - r}$$

S_{max} = maximum stress for infinite life with stress range r.

r = the range ratio for the cycle using the algebraic quotient, that is,

$$\pm \frac{\text{Min. Stress}}{\text{Max. Stress}}$$

S_{-1} = the normal fatigue limit when $r = -1$ (complete reversal).

This formula is based on the assumption which conforms with a few test data, that the S_{max} from a range of 0 to a maximum stress ($r = 0$) is 1.5

Table 3: Effect of Cold Work

	Chemical composition						Tensile properties							
Material	C	Mn	Cr	Ni	Si	Treatment	Ult. Str. (Lb. per sq.in.x1,000)	Y.P.	P.L.	Elong. in 2 in. (per cent)	Red Area	Fatigue limit Lb. per sq.in.	F.L./T.S.	Authority
Wire	0.66	0.67	....	....	....	Hard drawn	136	....	53	..	..	54,000	.40	[11]
Wire	0.66	0.67	....	....	....	Hard drawn and blued at 700 deg. F	132	....	95	..	..	58,500	.44	[11]
Armco iron	....	....	....	....	....	Annealed	45	20.2	..	43	61	22,000	.49	[14]
Armco iron	....	....	....	....	....	Reduced 55 per cent by drawing	89	57.5	..	13	50	40,500	.46	[14]
Tie rods	0.51	0.66	....	....	....	Cold drawn	133	....	48	21	62	62,000	.47	Wright Field
Wire	0.12	....	18.8	8.4	....	Annealed	99	54.8	28	57	73	41,000	.41	Wright Field
Tie rods	0.12	....	18.8	8.4	....	Cold drawn	112	91	40	46	..	62,000	.55	Wright Field
Tie rods	0.11	0.41	18.4	9.6	0.51	Cold drawn	135	100	30	24	54	74,000	.54	Wright Field

times the fatigue limit for completely reversed stress (S_{-1}).

Relation to other properties

Ferrous metals. The chemical composition or method of manufacture, that is, by open hearth or electric furnace, apparently has very little, if any, effect on the fatigue limit except as it may influence the amount of segregation or foreign particles in the steel. The comments of several investigators are practically unanimous in this regard and as summed up by Gillett and Mack[4], "the endurance properties are concordant with the tensile strength obtainable and are not peculiar to the chemical composition."

The fatigue limit bears a much closer relationship to the tensile strength and Brinell hardness than to the proportional limit, yield point, elongation, reduction of area or impact strength. It may be above or below the proportional limit. The ratio of fatigue limit to tensile strength varies from 0.40 to 0.60 and is often assumed to be 0.50. It is not constant, however, as it is affected by several variables which may not affect the tensile strength, such as, variation in structure, presence of seams, blowholes, either internal or external and presence of internal strains in the material due to heat treatment or cold work.

The close relationship between tensile strength and fatigue limit is shown in Table I. Specimens were machined from the main bearing and cheek of a six-throw crankshaft so that the forging flow lines were parallel to the axis of the specimen. The cheek material is worked more in forging and has higher tensile strength and fatigue limit.

The effect of variation in microstructure is shown in Fig. 3. The specimens were cut from the threaded ends of two different types of streamline tie rods. The chemical composition in both cases conforms to S.A.E. 1050 steel. Specimen *A* was manufactured from an $\frac{11}{16}$-in. hot rolled rod which was heated to 1,900 deg. F., air-cooled and then reduced in three drafts to a $\frac{1}{2}$-in. wire. Specimen *B* was manufactured from a similar rod which was pit annealed, reduced in two drafts to $\frac{1}{2}$-in. wire and then quenched in oil from 1,450 deg. F. and drawn in lead at 1,000 deg. F.

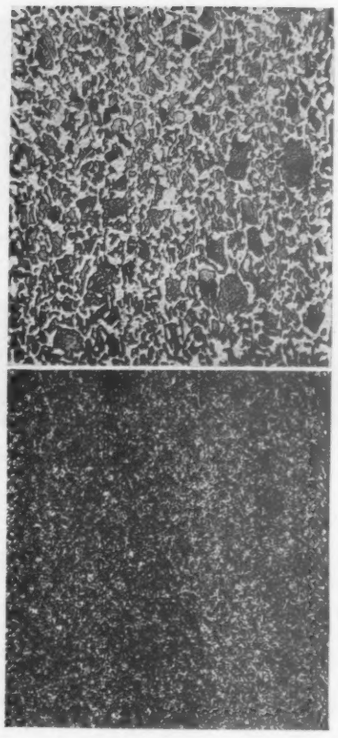


Fig. 3: Structure of streamline wire, magnified 100 times. (Etch 2 per cent nitric-alcoholic). Coarse grain (above) laminated pearlite and free ferrite. Fine grain (lower) sorbite and well distributed ferrite.

Non-ferrous metals. The fatigue limit of non-ferrous metals does not show the same relationship to tensile strength as in the case of ferrous metals. In general, annealed material does not have as high an endurance limit as strain hardened (cold worked) material. The tubing used for the tests shown in Fig. 2 was taken at random from stock used for manufacturing fuel lines. The copper tubes were $\frac{3}{8}$-in. outside diameter by 0.052 in. wall thickness. The duralumin tube was $\frac{3}{8}$ x 0.035. The physical properties were as shown in Table 2.

The specimens from which the curves (Fig. 2) were drawn were machined and polished on the inside and outside surfaces. Specimens were also tested with the original mill finish. The results are shown by the circles. The slight pits and scratches in the original surface reduce the fatigue limit of the strain hardened tube approximately 20 per cent at 10,000,000 cycles. The reduction is less for the annealed tubing or 14 per cent.

The results on polished copper tubing agree favorably with results on polished specimens from solid bars obtained by other investigators, especially for the annealed material.

In the case of pure aluminum, the difference between annealed and strain-hardened material is less marked. Templin[20] reports 7,000 lb. per sq.in. for the former and 8,000 lb. per sq.in. for the latter. Heat treatment of duralumin also affects the tensile strength and yield point to a much greater extent than the fatigue limit. The tests on duralumin tubing shown in Fig. 2 were not run much beyond 200,000,000 cycles which may account for the comparatively higher value for the tubing over the bar stock.

Fatigue limits cannot be predicted from previous results on alloys made from the same base metal but with a different composition.

Cold work or heat treatment

The tensile strength, proportional limit and hardness of the metals used in aircraft construction are increased by normal cold working such as rolling, drawing and spinning. Structural carbon and alloy steels, duralumin and other non-ferrous metals are affected in the same way by quenching and tempering or aging. The fatigue properties are also affected. In the case of ferrous metals, the ratio of fatigue limit to tensile strength remains practically constant provided the specimen is machined and polished. McAdam's[9] results indicate this is true for monel metal. In the case of some other non-ferrous alloys previously mentioned, the ratio is not so constant.

The methods used in cold working often abrade or distort the surface, causing scratches and minute cracks which reduce the fatigue properties. The tests reported in Table 3 were made on machined and polished specimens, and the effect of any original surface defects is not indicated.

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Design trends in approved type airplanes

By Clarence M. Young
Assistant Secretary of Commerce for Aeronautics

Clarence M. Young

For almost four years the evolution of American airplanes and engines has been under the supervision and general control of the Department of Commerce. Every design has been checked in detail and approved before it has gone into general production for commercial service. What has been the course of that evolution? How does payload, or maximum speed, or wing loading in 1931 compare with the figures for 1929 or 1927? There has been a deal of loose speculation on those topics, but relatively little citation of specific evidence. Now the Department has made an analysis to determine the facts. The results of their study stand in this article by Secretary Young, prepared especially for AVIATION, which it is our privilege to present.

AIRPLANE designers in the past four years have been striving for greater speed, with the result that the average speed of models receiving approved type certificates from the Aeronautics Branch of the Department of Commerce has been gradually increasing. Along with this increase in speed, however, there has been a decrease in the average of payload carried in comparison with horsepower, and also in comparison with gross weight. Moreover, there has been an increase in the average landing speed.

These and other trends in design practice have been analyzed by the Aeronautics Branch of the Department of Commerce on the basis of designs for which approved type certificates have been issued. The study was an impartial survey of the data as a whole. We were not concerned with improvements or deficiencies in individual designs, or with the number of craft built under any certificate. Rather, we sought to determine what had been the general average trends in airplane designing, as indicated by the approved type certificate models.

The material used involved 390 airplanes which were awarded approved type certificates between March, 1927 and December, 1930. The first approved type certificate for an airplane was granted in March, 1927. A somewhat less extensive investigation of engine types involved 65 engines receiving certificates between April, 1928, when the first engine certificate was issued, and December, 1930. The 455 certificates for airplanes and engines were issued to 140 companies. Many of the designs are no longer manufactured, but in most cases a type discontinued was used as the starting point for development of another model.

With respect to airplanes, the greatest activity in designing new models appears to have been in 1929—at any rate the number of approved type certificates issued then was greatest. The peak in issuance of approved type certificates was reached in the third quarter of 1929, when 19.2 per cent of all certificates for the three and three-quarter years were issued. The last three months of 1930, on the other hand, provided only 5 per cent of the total number of certificates.

Power loading decline

However, despite the variations in number of certificates issued from month to month, the trends in various specific phases of designing were found, in most cases, to have taken definite courses.

To take a specific example—power loading declined throughout the period. Averages for power loading, and all other trends as well, were computed as of quarter years over the three and three-quarter years period. It was found that the trend in power loading had been downward in nearly every quarter. At the same time, wing loading increased. In other words, the average approved type certificate model for a given useful load was being supplied with a power plant of greater horsepower, and therefore was being increased in empty weight, an increased weight due in part to the heavier engine and in part to the stronger structure necessary to accommodate it. However, this weight was not compensated for by an increase in wing area. On the contrary, the wing area remained about the

same—the increase in power going for greater speed.

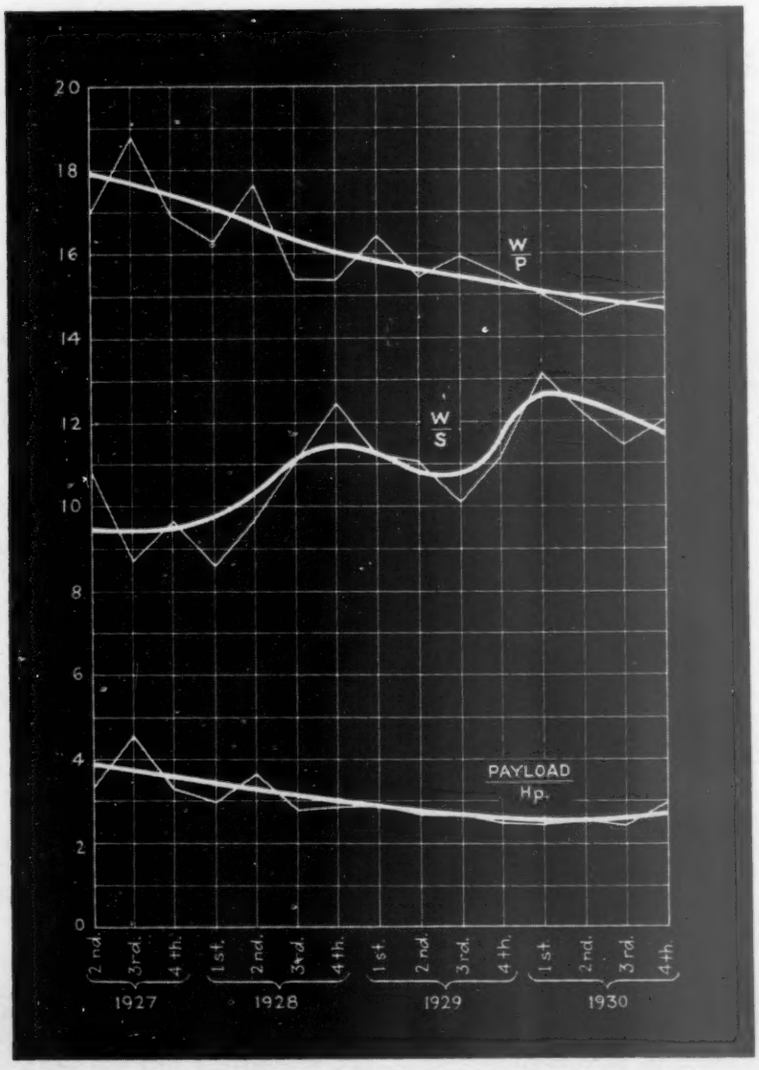
This may be illustrated in terms of the airplane market, as follows: Many airplanes originally equipped with, say, 200-hp. engines have been revised in design until the same models, with the same seating capacity and payload, now are equipped with engines developing as much as 450 hp. For another type of airplane, the increase may have been from 90 to 225 hp.

This increase in power, had it been accompanied by an increase in wing area, would have permitted the airplanes involved to carry more payload. The increase, however, was effected with maximum speed in mind, and the final effect upon payload was, in general, to reduce it.

Payload carried has decreased both in proportion to horsepower and in proportion to gross weight. A study of these two trends showed declines in a majority of the quarters throughout the period.

Designing for high speed at the expense of payload, of course, is not necessarily poor practice, since a craft so designed may serve admirably for the purpose intended. Moreover, the fact that the average approved type airplane now carries less payload in proportion to engine horsepower and in proportion to gross weight than formerly, is true in spite of the fact that some individual designs have been thought out carefully with payload as a primary consideration. It means simply that a majority of the designers submitting new models have considered increased speed the most desirable objective.

Another study of these two payload trends for airplanes of various weight classes clearly demonstrated that the planes intended primarily as cargo carriers were being designed efficiently from that point of view. It was found, by studying designs of planes varying from 1,500 to 24,500 lb., approved in 1929-30, that the larger airplanes were most economical and most efficient with regard to the ratio of payload to horsepower, and payload in per cent of gross weight.



Power loading, wing loading, and payload per horsepower—the history of their average variation, by quarter years, on approved designs. The heavy lines show long-term trends.

With respect to payload as compared with engine horsepower, it was found that for airplanes of 5,000 to 10,000 lb. gross weight, the ratio was approximately 3 lb. of payload to one unit of horsepower, as compared with about 2½ lb. per unit of horsepower for smaller craft. Above 10,000 lb. there was a very slight increase in payload as compared with horsepower as the gross weight increased.

With regard to payload in per cent of gross weight, the larger planes again were most efficient. For airplanes weighing up to 5,000 lb. the average varied between 15 and 20 per cent, with the heavier planes rating as most efficient. Above 5,000 lb., the percentage of payload climbed gradually with increase in gross weight.

This indicated that the heavy transport planes had been designed with consideration for their qualities as efficient load carriers, while the smaller planes, meant for carrying two or three passengers, were planned with less consideration for their ability to lift payload.

This phase of the study was considered to be of particular interest in view of the theory frequently advanced that the efficiency of heavier-than-air craft must necessarily decrease as size is increased. The theory could not be said to have been disproved by the results of the survey of approved type models, but at the same time the study did show that designers have not yet encountered the difficulties that theory forecasts.

In none of the trends that have been mentioned in the foregoing discussion has there been any great and sudden change. In each case the direction of the trend was definitely established, but the changes were found to be taking place at a conservative pace.

Trend to higher speeds

Likewise, with regard to speed of airplanes, the change was not sudden, nor was it great. The matter of interest in the study was that the trend was unmistakably toward higher speed.

Average high speeds varied during the period of survey (averages again being computed by quarter years) between the approximate limits of 101 and 137 m.p.h. The speeds are referred to as being approximate because they are calculated values taken from the designs according to an empirical table, and are not manufacturer's claims or actual test results of individual models.

At the beginning of the period covered by the survey, the average top speed was 117 m.p.h., and at the end of the three and three-quarters years it was 126. Thus, the actual gain over the entire period was approximately 10 m.p.h.—the lower and higher limits having been touched during intervening quarters. There were times when the average high speed fell back somewhat,

Average power and wing loading, payload, and speeds of approved planes

Year	Quarter	Average power loading in lb. per hp	Average wing loading in lb. per sq. ft.	Average payload in per cent of gross weight	Average payload in lb. per hp.	Average top speed in m.p.h.	Average landing speed in m.p.h.
1927.....	2nd	17.00	10.80	19.1	3.35	117.0	57.0
	3rd	18.80	8.70	24.5	4.55	101.0	52.0
	4th	16.90	9.65	20.7	3.25	110.0	54.0
1928.....	1st	16.30	8.60	19.4	3.00	107.0	52.0
	2nd	17.65	9.75	21.4	3.70	108.0	54.0
	3rd	15.40	11.15	18.2	2.80	120.0	58.0
	4th	15.40	12.45	18.7	2.85	125.0	61.0
1929.....	1st	16.40	11.15	17.7	2.90	118.0	58.0
	2nd	15.45	11.05	17.2	2.65	119.5	58.0
	3rd	15.90	10.07	17.0	2.65	116.5	56.5
	4th	15.50	11.15	16.1	2.45	119.5	58.0
1930.....	1st	15.00	13.10	16.4	2.40	137.0	63.0
	2nd	14.50	12.15	17.7	2.55	127.0	60.5
	3rd	14.75	11.40	16.4	2.40	122.5	58.5
	4th	14.90	12.00	20.3	2.95	126.0	60.0

but the general trend was upward.

The trend in landing speed followed that for high speed—the two rising together.

The average trend of design for the past four years or so has been, generally speaking, in the interest of high speed and at the expense of payload and landing speed.

In the last quarter of 1930 the study showed that speed had been gained without as much sacrifice as had been the case previously. There was an increase in average speed, and at the same time a marked increase in average payload in per cent of gross weight and average payload per horsepower—presumably the result of careful and efficient design, since it would have been normal for payload capacity to have decreased with the increase in speed.

Landplanes predominate

To proceed to another phase of the study, it was found that landplane types predominated among the approved type models. Approximately 87 per cent of the total number of certificates issued were for landplanes. Seaplanes accounted for about 7 per cent of the total, and amphibions about 4 per cent. The number of flying boats was less than 2 per cent of the total.

Open cockpit planes led cabin planes by a large margin at the beginning of the period, about 80 per cent of the approved types in the first quarter considered being of the open type. Considering the entire period, however, the division between the two types was almost equal. To be more exact, the average percentage of open types was approximately 55 per cent, and of closed types 45 per cent.

Monoplanes were found to have experienced a gain in popularity, as far as approved type applications were concerned. Although biplane types led among approved type certificates at the beginning of the period, monoplane types gained rapidly in number, until they exceeded biplane types during the fourth quarter of 1928. Through 1930 monoplane types were in the majority in each of the quarters.

Approved engines

The study of approved type engines was concerned with the relative number of certificates issued to various types. It was found that radial air-cooled engines led, with in-line air-cooled, vee type water-cooled and vee type air-cooled following in the order named. In-line air-cooled engines have found increased favor with designers, at least to the extent that the number of approved type certificates for these engines has increased. This trend points to the effort to avoid the frontal resistence occasioned by the radial type of engine.

Each of the trends mentioned heretofore was computed on the basis of actual mathematical averages. In addition to this, the investigators made a number of general observations which were not substantiated in this way, either because they did not lend themselves to that type of treatment, or because the trends were so pronounced that it was deemed unnecessary to plot points and draw curves.

For example, it was noticed that new uses were being found for metal. Many designs were received which involved steel tubing fuselages and stamped metal parts. In addition, the metal monocoque fuselage appeared in several designs.

Light plane applications

Toward the end of the period of the study a number of applications for approval of light, low-powered airplanes were received. These designs figured to some extent in the general averages for the latter part of 1930, but the approvals for these types were greater in number after the beginning of 1931, and the light airplane is really a trend of 1931 rather than 1930, as far as approval of types is concerned.

Development of shock absorbing gear of increased efficiency has induced many designers to abandon the rubber shock cord in favor of compression units employing rubber, compressed air, or oil cushions. With an increase in the use of wheel brakes, there has been a decrease in the use of tail skids—the tail skid being replaced by a third wheel.

From the standpoint of the public, probably the most noticeable innovations have been those looking toward greater comfort for transport planes. These large craft have been equipped with comfortable reclining chairs, reading lights, adequate ventilating facilities and other features intended solely for the immediate benefit of the passenger.

Each change that has been made in designing, whether a small matter such as a cabin fitting, or a substantial one like a change of structural design looking toward increased speed, was made with the idea of improving the airplane, making it more efficient, and better equipped to perform its task of providing speed and directness of route in air transportation.

Issuance of approved type certificates by quarter years

Year	Quarter	Number approved	Opens	Closed	Per cent closed	Flying boats	Monoplanes	Biplanes	Per cent monoplanes
1927.....	2nd	9	7	2	22	0	2	7	22
	3rd	6	3	3	50	0	0	6	0
	4th	6	4	2	33	0	2	4	33
1928.....	1st	9	5	4	44	0	2	7	22
	2nd	15	9	6	40	0	6	9	40
	3rd	24	10	14	58	1	10	14	42
	4th	23	10	13	57	0	12	11	52
1929.....	1st	35	20	15	43	0	11	24	46
	2nd	38	21	17	45	1	14	24	37
	3rd	75	45	30	40	0	35	40	47
	4th	36	18	18	50	1	22	14	61
1930.....	1st	20	10	10	50	1	12	8	60
	2nd	30	14	16	53	0	20	10	67
	3rd	37	21	16	43	2	20	17	54
	4th	19	11	8	42	0	11	8	58
Totals.....		382	208	174	...	6	179	203	...

The Winnie Mae at Edmonton Airport. The difficult surface conditions encountered there forced a take-off from a paved highway

Nine days around the world

Mechanical aspects of the great flight,—equipment, preparation, and servicing

THE great achievement of Wiley Post and Harold Gatty contrasts strangely with the only previous successful attempt to fly around the world. Only seven years ago it took an expedition of the United States government more than five months to complete its circumnavigation. Post and Gatty, as the whole world knows, did it in less than nine days. Great as was the difference in time, however, there was an even greater difference in the conditions under which the flights were prepared for and made, differences corresponding to the difference between a government with unlimited resources, but working through the often tedious toils of political machinery, and a private expedition planned by men who had only themselves to depend upon and who were habituated to the lifelong necessity of making limited money and means go as far as possible.

Post and Gatty sent out no advance parties to make arrangements for them. They depended on the normal facilities of the countries that they visited. They used stock equipment with a minimum of alterations,—only those which were absolutely indispensable. Having no governmental connection, the political questions which were so complicated when the Army flight was made, disturbed them not at all. American non-recognition of the Soviet government did not prevent them from crossing Russia. Arrangements were made through Amtorg, the Russian trade representatives in New York, and were effective in preventing any delays over passports or other formalities. In Russia and the other European countries regular airports and services were used, and very little was done in advance to prepare for the Winnie Mae's arrival. Language difficulties, naturally somewhat acute, were solved by aviation authorities in Moscow when they wrote out for the pilot the Russian equivalents of all the requests and instructions that he thought he might want to convey to his helpers at the Siberian stops.

Stock model plane and engine

The plane was a stock Lockheed Vega built early in 1930, and was the same that was used by Post in winning the non-stop race from Los Angeles to Chicago in the National Air Races last year. A special hatch about three feet by two was cut from the top of the fuselage just at the trailing edge of the wing for the use of the navigator. The panels of the hatch swung inward, and a wind shield swung up to protect Mr. Gatty while taking sights.

In preparation for the flight most of the seats had been removed from the cabin and an extra gasoline tank installed in their place. Other tankage was standard, and the total gas capacity was 540 gal. A 30-gal. oil tank was used. The fuel feed from the wing tanks was by gravity, with an Aircraft Devices Corporation motor-driven pump for the cabin tank and a hand wobble pump for use in case of emergency, which did not arise. The fuel system had the usual control by the pilot through a three-way valve, permitting the drawing of fuel either from the fuselage tanks or from those in the wings. The NC license which the plane had originally borne was cancelled when the structural changes were made, and a restricted license replaced it.

Pilot and navigator, their compartments separated by the big fuselage tank, communicated through a speaking tube about five feet long. In the latter

stage of the flight, Mr. Post's hearing had been affected by the constant roar of the engine and thereafter messages were passed to and fro along a wire.

The power plant was a Pratt & Whitney Wasp, completely standard except for the replacement of the usual 7 to 1 blower by one geared 10 to 1, which raised the output to 525 hp., and converted the engine from a Series C to a Series SC on the manufacturer's list. The change of gears was made on the West Coast just prior to starting for Roosevelt Field and at that time the engine, first shipped from the factory on May 20, 1930, had had 245 hours of service, including the non-stop flight from California to Chicago during the air races. The engine accessories were standard except for the elimination of a starter, which was left off to save weight. The engine was started by swinging the propeller, and that operation caused one minor mishap which might easily have been very serious.

The supercharging effect of the high-geared blower required fuel of exceptional quality. The gas used everywhere except in Russia was Stanavo specification and had 3 c.c. of ethyl fluid added to each gallon to give it an anti-knock rating of 87 on the octane scale. The gasoline furnished in Russia was excellent, but contained no ethyl fluid. To meet that exigency the center wing tank was filled with ethyl gas at Berlin and was used without refilling for all take-offs from there to Nome. After getting into the air the engine was switched over onto another tank containing the Russian gasoline and throttled back to 1,700 r.p.m., at which speed no ethyl was necessary to prevent detonation. Thermocouples, reading the cylinder-head temperatures, gave warning if detonation conditions were too nearly approached. At full throttle, the supercharged engine turned the metal propeller, 9 ft. 2 in. in diameter and with a 21¼-deg. pitch setting, at 2,200 r.p.m. in level flight.

Extra navigational aids

A number of extra navigational aids were carried. The normal complement of Pioneer instruments for cross-country flying was modified by the elimination of the ordinary turn and bank indicator, a Sperry artificial horizon and directional gyro being used instead. The two gyro instruments contributed a total weight of 16½ lb. The directional gyro serves essentially the purpose of a gyro compass, but has its correcting and self-aligning devices omitted and can be set for any course. Independent of rough air and of banking of the plane, it is nevertheless capable of wandering gradually from its true indication, and has to be checked up periodically against a magnetic compass. Two Ritchie aperiodic compasses were used for basic reference. There was no magneto or earth inductor compass. Navigation proper was done with a drift indicator, Gatty's invention, and a bubble sextant.

The engine had shielded B. G. plugs, the first time that shielded plugs have been used on any of the great spectacular flights. They were of course intended to help the radio along, but the radio installed was of very low power and practically no use was made of it.

Few mechanical needs

The story of the mechanical features of the flight itself and of the servicing work before, during, and after is almost too simple to require telling. The machine was practically ready to start for Europe when it arrived at Roosevelt Field from Oklahoma and the only purchases during the weeks of waiting on the weather were fuel, oil and tires. The latter, of high-pressure type, gave a considerable amount of trouble during the period of preparation, but none during the flight itself.

At Harbor Grace, valve clearances were checked but no work was done. From the time of leaving New York until the arrival at Khabarovsk, 9,010 miles away, servicing consisted of refilling the gas and oil tanks and giving the usual attention to rocker arms and other parts normally receiving daily lubrication,—nothing more. At Khabarovsk the Russian oil, which was considerably inferior in quality to their gasoline, began to tell and six plugs were changed. That made deep inroads on the supply of spare parts, as the entire servicing equipment carried on the flight was a standard tool-roll and a complete set of plugs.

At the next stop, Solomon Beach just outside of Nome, the only structural damage of the flight was suffered when one wheel dropped into a hole in the field while taxiing, bending the cowl over the wheel and one blade of the propeller. The propeller blade was straightened out and Mr. Post was quite willing to go on to the finish with it, but on arriving at Fairbanks Alaskan Airways, the Pratt & Whitney service representatives in that part of the world, produced and installed a new pair of blades. It was at Fairbanks that Mr. Gatty's shoulder was injured by being struck by the propeller while cranking the engine. At Fairbanks, also, the oil was changed.

The nine days over and Roosevelt Field regained, the plane needed no attention before starting for the West. The regular twenty-hour check was given the engine, with no replacements found necessary except a new set of plugs. The compression, according to the man who supervised the work, was perfect, the connecting rods all in proper condition, and the valve gear free from any undue play. Plugs that had gone all the way from Roosevelt Field to Roosevelt Field again showed an increase in gap of 0.014 in.

Post and Gatty with coffee and sandwiches to sustain them on the first lap of their flight, Roosevelt Field to Harbor Grace

It can be done. Though flying club operation has not attained much success in this country, the experiences of a number of individual groups convince us that the method is fundamentally sound. Many clubs have come and gone; the N.A.A. plan and those of certain manufacturers have been greeted with indifference, while through it all the splendid record of the British and Canadian clubs has stood as an inspiration. There must be a right way to operate a club, or none would have survived. This article, based on what some have actually accomplished over a period of time, indicates a real opportunity. Mr. Moodie is no mere theorist. He has successfully practiced what he preaches.

Reaching a private market with flying clubs

By Edmund L. Moodie

TO ONE who has been a salesman in the field, it seems that in order to sell airplanes it is all too necessary to sell aviation first of all. The response: "I'll fly if I can keep one foot on the ground," though trite still indicates the attitude of a large proportion of the public. The ability of the salesman to replace this feeling with a faith in both the safety and desirability of flight determines whether or not he is able to interest the uninitiated in a personal airplane.

The great majority of the ultimate users of personal planes are at present uninitiated. Greater effort should be made to reach them directly rather than to rely on the development of prospects through commercial operators or among those who learn to fly at various schools throughout the country. Of those using aviation facilities now, the patron of the scheduled airline may not find it convenient or economically sound to buy a plane for pleasure and business. The man who takes a flying course more often has the idea of using his knowledge professionally than of owning a plane. And, anyway, to spend from $200 to $4,500 at a flying school merely to be able to pilot one's own plane is not economically justified.

It is, of course, not as simple to learn to fly as it is to drive a car. Neither is it possible to find as much use for a plane as for an automobile and the cost of owning a plane is as high if not higher. However, it does not follow that the ordinary individual has no use for a plane, nor that he should wait until its operation becomes simpler and until he can put it to as much use as he can an auto. To do so deprives him of a form of recreation and personal transportation that has conspicuous advantages.

The manufacturer has been evading the issue by leaving it to the flying school and to others to find new users of aircraft. The results have not been encouraging nor productive of a profitable sales volume. The flying school has trained a great number of pilots, but as a rule they cannot afford to use and maintain a plane of their own, or they plan to engage in aviation commercially. The manufacturer must find a new outlet and devote himself more to the expansion of his own market.

The great majority of the ultimate users of personal planes are at present uninitiated . . . the average individual . . . who can make an initial investment of $300 or $400 and a weekly outlay of $5 is a prospect under the group plan.

The flying club's place

It is suggested that the flying club (group ownership) is an outlet that has not been properly developed. Though much maligned, the flying club is entirely desirable and workable. It has never really been given a fair opportunity to take its indicated place in this country's aviation layout. It is becoming more and more evident that the failures of most group ownership projects in recent years have resulted from factors which should be entirely avoidable in the light of contemporary experience.

Hasty organization, extremely limited financial responsibility or backing, poor business management, lack of proper professional supervision, lack of insurance coverage, lack of encouragement from the industry, and the downright disparagement of the idea poured forth freely by commercial operators, have eaten the heart out of most club attempts. Obviously, failures from these causes reflect not a bit on the idea itself

but merely emphasize where improvement can and must be made.

Cooperative ownership is based on the recognition of the fact that there frequently is not, at present, sufficient justification for individual ownership. The training necessary involves a long period of time and the expenditure of a comparatively large sum of money. One advantage of cooperative ownership is that it interests those who might not care to take up aviation as a profession, though it is often difficult to organize a group of individuals having mutual interests and equally capable of assuming the responsibilities of joint operation.

. . . as the individual's training proceeds, the desirability of aircraft as a factor in his own situation will become apparent.

A distinct obstacle is the impression that the group plan interferes with the business of the local airport by taking away potential students of the local school. Commercial operators almost universally frown on the flying club. An analysis will usually reveal, however, that those who become interested in a group plan would not be interested in a flying school course. They are interested in learning to fly only if it paves the way to individual ownership and provides not only familiarization with the art of flying but with some of the problems of ownership.

Benefit to local operator

In reality there is an advantage to the local operator in that the burden of ownership is shifted from his shoulders to those of the real users of the plane, and he can still sell his services as an instructor at the usual rate and derive an income from the sale of hangar space, repair service, oil and gas. Eventually he will be called upon to sell additional equipment to the group or to individuals within the group. The result will be to place him in a position comparable to that now held by the small-town garage in the automobile industry — commonly carrying its overhead by the sale of storage, repair service, oil and gas,—deriving a profit from the sale of automobiles.

To the manufacturer who assists in the formation of plane-owning groups, there are the benefits to be derived from direct contact with the real and ultimate users of aircraft. At present, his contact is with the commercial operators. The needs of the operator—even those of the flying school—are not those of the private owner. The individual wants a plane which appeals not only from the standpoint of economy and performance, but also from the standpoint of appearance, comfort and usefulness as a means of cross-country travel. The flying school may want a plane that is easily maneuverable, but the plane that maneuvers easily may not be as comfortable to fly cross-country as one more stable. The flying school is not interested in appearance and quality of finish as much as in ruggedness and ability to withstand hard service. The private owner is interested in a plane for individual use; the flying school is interested in a plane that will find a diversified use.

The manufacturer does not sell the private owner when he sells the airport operator or the flying school. The manufacturer cannot reasonably expect a product that meets the needs of the commercial operator to appeal equally to the private owner. This has been frequently demonstrated. The planes that have appeared on the market to be sold to schools and commercial operators have not been widely accepted for private ownership. Planes expressly for the private owner have not met with approval from the commercial operators. The solution for the manufacturer of the latter is, therefore, to *ignore the commercial operator—even the flying school*—and sell to the individual or to a group, bearing in mind of course that the group must have a plane it can learn to fly as well as to go places in.

It is possible to insure such equipment against accidental damage so that the problem of having a member of the group destroying the property of the rest beyond replacement is not insurmountable. Even for small groups, insurance is desirable. The man who damages his own property can replace or repair it at such time as his finances will permit. If however, it is the property of a group it must be repaired or replaced at once or the whole group suffers because of the financial condition of one person.

The average individual in a community who can make an initial investment of $300 or $400 and a weekly outlay of $5 or more is a prospect for the purchase of an airplane under the group plan. His need of a personal plane may not be apparent. But his desire to learn more about aviation will provide sufficient incentive and his need will increase as his ability to fly develops, and as the facilities for air travel improve.

If it is granted that the individual needs more or less careful supervision for a period of at least six months, it can be readily seen that the group plan of private ownership has definite advantages.

Approaching the prospects

Several methods of approach to those within the community who might be interested in a group project are possible. Experience in this sort of work develops which methods are best. In large cities groups are more difficult to contact. The inaccessibility of airports at large centers of population and the diversity of interests creates special merchandising problems. In general, it may be said, however, that the flying club market in large cities is confined to those living adjacent to a given airport and that the smaller communities lend themselves best to group development.

It is recommended that the initial cost include the insurance premium (preferably paid by the manufacturer) for full coverage on the plane for six months or a year. Based on a group of twelve, the initial cost of an average modern production plane suited for non-professional use, will thus be in the neighborhood of $300 per person. Few factories at the present time have built up a really useful dealer organization and, inasmuch as this type of selling is development work, it should be handled directly by the manufacturer. The dealer can be protected on subsequent sales that he may effect.

The inclusion of the insurance premium as part of the cost of the plane gives a figure closely approximating the retail price, and the manufacturer need not, therefore, publish his factory price. The plane is being sold at the list price but the insurance premium is paid by the manufacturer as an added inducement to the local group. Any margin between the list price and the factory price not taken up by the cost of insurance helps defray the expense of this method of selling.

During these so-called hard times it is not easy to find ten or twelve worthy

Planes expressly for the private owner have not met with approval from the commercial operator. The solution for the manufacturer is to ignore the commercial operator—even the flying school—and sell to the individual or group.

citizens desirous of being indoctrinated in aviation technique who have sufficient cash in the bank to make an immediate outlay of $300. Credit can be sought through the finance companies now operating in the aviation field, or the local bank may be asked to cooperate and at least one-half to two-thirds of the amount involved can be borrowed from the bank on three to twelve-month paper. This is accomplished by having the group sign a joint note payable to the bank. No security is necessary as there can and should be enough "good names" on the note to guarantee to the bank the repayment of its loan. This is not theory. It has actually been worked out and applied. It is paramount to the success of the group plan that the individuals composing it be able to share equally the financial burden of the venture. A payment of at least $100 in cash from each one is necessary in order to establish a certain basis of financial equality, although of course the first approach should in any case be made to persons whose interests and associations establish a certain social equality and congeniality. If a prospective member of the group can raise $100 in cash it is fairly certain that he will be able to carry the other obligations. If he defaults, on the other hand, it is a comparatively simple matter to find a substitute. It can be provided in the by-laws of the organization that anyone defaulting loses what he has paid in and the money is applied to the amount expected of the one who comes in to take the place of the defaulter.

In addition to the initial fee of $100 there should be a monthly payment of $15 to $25 for about one year to retire the note which has been discounted. The rate for dual will be about $10 to $15 an hour and $5 or $6 for solo. The club may lose money on the dual rate but should make money on the solo and build up a reserve which can be held as a fund to take care of overhauls and the replacement of equipment, or for the purchase of additional equipment. The instructor will be paid by the hour out of the money received for dual and the services of the local pilot or airport operator can be enlisted on such a basis.

How much should it cost?

The weekly expenditure for flying time depends on the individual and the extent he avails himself of the opportunity to fly. It probably will average at least $5—one hour—but there is no limit to the top sum. If aviation is here to stay and if private ownership is coming, it stands to reason that the person who takes up aviation at the present time with the thought of developing it for his own use is in aviation to stay; and the amount of money that he will spend depends only on his own capacity or desires. At the same time it can be pointed out that there is no requirement for spending money above and beyond the capacity of the individual at any particular stage. The president of the Malone (N. Y.) Aero Club, Clarence Dufort, found time to get a limited commercial license and then did passenger carrying for the club and by last autumn had piled up over 200 hours. He estimates that it cost him between $4.50 and $5.00 per hour for the 200 hours necessary to enable him to get a transport license.

The first year's expenses for an *ab initio* pilot for 10 hours dual and 20 hours solo would total about $500 to $600. Expenses the second year would be less, with the plane paid for in full.

As the economic justification for use of aircraft becomes more apparent and as the individual's training proceeds the desirability of aircraft as a factor in his own situation will become more apparent. Since it is obvious that the time is not far distant when use of planes will be common-place, it behooves the individual to learn something of its possibilities as well as of its limitations. The best way of acquiring this knowledge in its most usable form is to get it first hand.

"Club" features

Any club should have certain "club" features, the most important of which is social activities. The average flying club has ignored this phase, stripping the project to the bare skeleton of cooperative ownership. This not only endangers the solidity of the group, since any group depends in generous proportions upon the congeniality and close associations of the individuals, but robs the operations of the group of a great deal of pleasant relations. The flying clubs in the various parts of the British Empire furnish impressive examples of the part social activities may play.

The personnel constituency of the group, therefore, becomes of first rank importance. The individuals must be congenial as well as financially able to meet the obligations involved. In some communities such groups already exist and merely need to be enthused over flying as a sport and means of pleasant travel. In others, the group must be assembled. Service associations, the chamber of commerce, and banks are among the larger organizations within which individuals or groups may be recruited.

One of the most difficult obstacles to be overcome in the formation of the local club is the opposition of the local operator of the airport or flying school. As pointed out before, he fears it may interfere with the development of his school, or may interfere with development of his agency for a particular make of plane, especially if the club decides against his particular make for its first purchase. Many operators, moreover, are not awake to the changing trend within the industry and still cling to the idea that there is a livelihood to be had training pilots for commercial aviation.

It is possible to point out to the local operator, however, that the group plan will provide additional revenue that might not otherwise be forthcoming. Five of the active members of the present Ausable (N. Y.) Flying Club had never even been in a plane prior to the formation of this club and only three or four of the others had considered taking instruction. At its worst the flying club provides the local operator with ten or twelve new students all at one time.

If the community is to take advantage of the airplane, anything that encourages its development will be to the advantage of the local operator. It can readily be seen also that it is possible for the local operator to develop group ownership within his community on his own account.

The manufacturer's burden

The organization of groups places a definite burden on the manufacturer, as he has to take on the task of reaching the ultimate user of aircraft instead of leaving that task to the local operator and to the flying school. It seems apparent, however, that the local agencies have failed as a factor in distribution and a policy of direct-to-consumer merchandising will provide the support required for a more effective distribution. It has been well established in other types of industry that chain stores and other direct outlets from the factory to the consumer have effected definite economies and more efficient distribution. The development of group ownership *by the manufacturer* is a step in merchandising practice justified by experience in other and older phases of commercial activity. It has obvious advantages in that it brings the manufacturer into direct contact with the ultimate purchaser of his product and allows him to become familiar with the needs and desires of that user. It provides a direct sales contact which is not as expensive to maintain as is the establishment of factory branches. The cost of sending men into the field to center their activity on the formation of flying clubs does not involve the overhead of branch offices unless and until the need for such branches develops.

In short, the much misunderstood flying club merits the serious consideration of the aeronautical industry, now more than ever before. It involves a change in merchandising policy but one that is in keeping with the times. Group ownership has its disadvantages but it is particularly useful in aviation merchandising to develop a market that cannot otherwise be reached, just as it is useful to the individual as the most advantageous means of taking up aviation until the piloting of aircraft becomes simpler.

Paradoxical as it may seem, it is sometimes possible to save money by spending it. This is particularly true where protection against losses by fire is involved. The accompanying article shows how National Air Transport obtained a reduction of 80 per cent in fire insurance expense by spending $24,000 for a fire protection system.

Reducing fire insurance costs

By James P. Wines

REDUCTION of 80 per cent in fire insurance premiums paid for coverage on its properties at the Chicago Municipal Airport has been achieved by National Air Transport, Inc. This saving effected by the operator of the New York-Chicago-Dallas air mail and passenger line is the result of the installation of one of the most complete sprinkler systems to be found in the country.

The plan of the fire-fighting system was evolved by Ralph H. Higgins, construction engineer of the airline, with the aid of Francis E. Slater, Manufacturers' Mutual Fire Insurance Company engineer. The insurance company is one of the Factory Mutual group. The equipment was supplied by Viking Automatic Sprinkler Company which handled the actual work of laying out and installing the system.

Mr. Higgins' idea was "to provide water when and where it is needed, and in sufficient quantities to cope with the most severe blaze." No expense was spared. The system cost approximately $24,000. In a comparatively short time, however, the reduction in insurance rates will more than compensate for this expenditure, for the buildings and equipment at the Chicago port are valued at $500,000.

National Air Transport occupies three adjoining hangars along the Cicero Avenue boundary of the field. Each has a two-story lean-to on the street side. The construction of these buildings is not out of the ordinary, save for the fact that the hangars are separated by single 14-in. brick fire walls. Elsewhere the walls are of 12-in. brick. The hangar roofs are of wood, and are supported by trusses. In the north hangar these are of wood, and in the other two, steel. The lean-tos have flat wooden roofs and fibre board ceilings.

The north hangar, or building No. 1, is 80 ft. in width and 140 ft. in length. This structure and its lean-to, which measures 30x100 ft., house the plane and overhaul shops, the instrument laboratory, stock room, radio department, propeller testing shop, boiler room and pump house. There is also a dope room, sealed off from the rest of the building by 12-in. fire walls.

With the exception of the pilots' quarters and the operations office, located on wooden galleries suspended from the

Above: The monitor nozzle on one of the N.A.T. buildings in operation. Left: Ralph H. Higgins, N.A.T. construction engineer, kneeling beside one of the roof hydrants and a monitor nozzle.

steel roof trusses, the whole of the central hangar is devoted to the servicing and storing of planes. Although 160 ft. across the front and 120 ft. deep, there are no interiors supporting columns in this structure, making it possible to house the new Ford tri-engined craft that N.A.T. is using in its passenger carrying operations without difficulty. The 30x80-ft. lean-to behind the building is occupied by the general offices of the transport line.

No. 3 hangar is the smallest of the group, measuring 80x100 ft. It has a gallery at the rear, which has been turned over to the photographic department, but otherwise the structure is utilized for storing planes. The lean-to at the back is the full width of the hangar and 20 ft. deep. The ground floor is devoted to a passenger station, used by both N.A.T. and Boeing Air Transport, and to quarters for the mechanics. The second floor houses the airport station of the U. S. Weather Bureau.

Closed head sprinklers

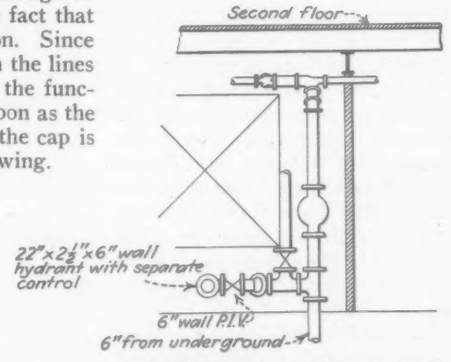
The sprinklers installed by N.A.T. are all of the closed head type, which of course operate independently. The automatic heads are of the standard 160-deg. and 212-deg. types, having full ½-in. water openings. The sole difference between them is in the melting point of the links with which they are fitted. Those with the 212-deg. links are used in the boiler room and at other places where the heads come in close contact with the steam lines, but by far the great majority are of the 160-deg. type.

There are 1,007 sprinklers in the entire system. All are of the overhead type, and are mounted just below the hangar roofs, the ceilings of the lean-tos and under the wooden galleries. In accordance with the rules promulgated by the National Board of Fire Underwriters and the Factory Mutual Laboratories for joisted ceilings, no more than 80 sq.ft. of floor area is allotted to each head. There are 336 sprinklers in building No. 1, 446 in the central structure, and 225 in the south hangar.

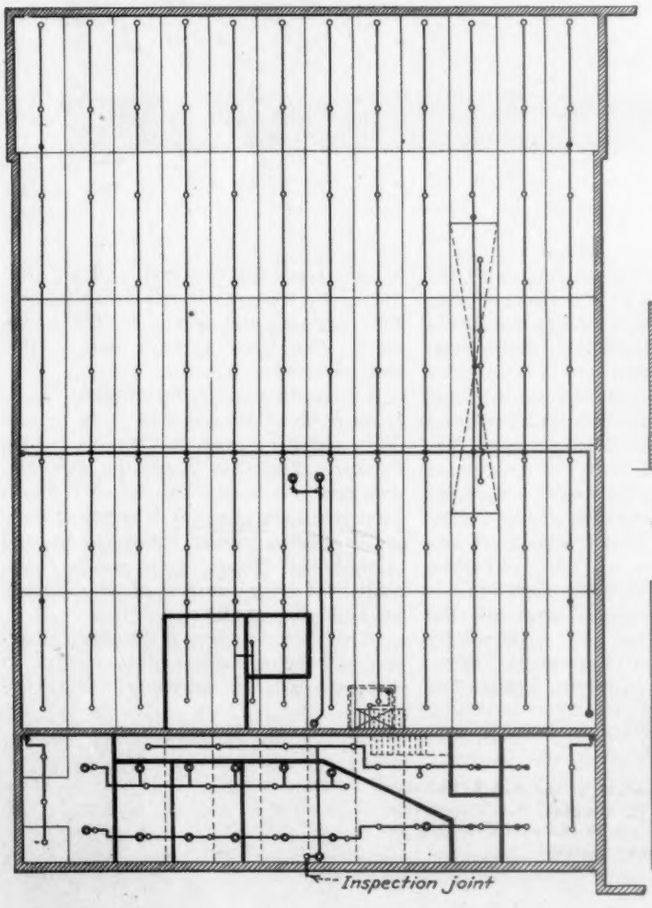
The installation of the sprinklers is such that the fire-fighting equipment in each hangar forms a separate unit. This makes possible the use of a wet-pipe system in the north hangar and convertible wet and dry-pipe systems in the other two buildings. The advantage of the wet-pipe system lies in the fact that it is the most rapid in action. Since water under pressure is kept in the lines at all times, there is no lag in the functioning of the sprinklers. As soon as the link at one of the heads fuses, the cap is blown off and water starts flowing.

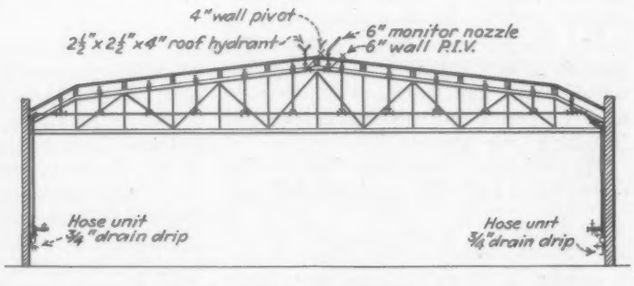
The objection to the wet-pipe installation is that the water in the lines may freeze during cold weather if the temperature of the building is allowed to drop too low. Such an occurrence in the north hangar, however, is considered only a remote possibility by N.A.T. officials. The structure is used solely for overhaul work, and the sectional doors at the front are seldom opened. As a consequence, no difficulty has been experienced in maintaining a fairly high temperature there even in the most severe weather.

The doors of the middle and south hangars, on the other hand, are constantly being opened in taking planes in and out. For this reason, the sprinklers in these two buildings are operated on the wet-pipe principle during the summer months and the dry-pipe in the winter. In changing from the wet to the dry-pipe system, the water is drained out of the lines to the sprinklers, and 20 lb. of air is substituted. The pressure

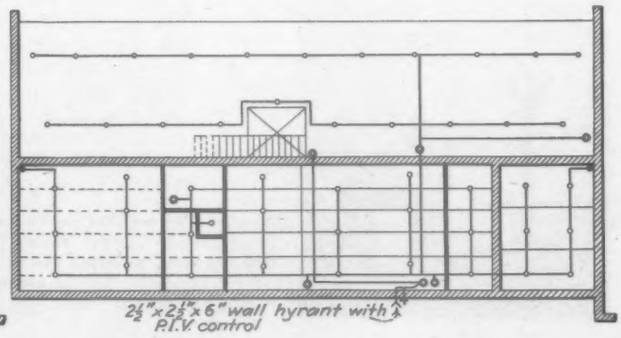


Elevation of dry valve and monitor nozzle connection





Layout of a sprinkler system in a two story hangar. Above: Cross section. Left: Second floor and roof. Below: First floor and deck.



of the air is sufficient to hold the water in check below the 6-in. Tyden dry valves installed in the mains.

Water from street main

The water supply is obtained from the 12-in. street main, which is joined by an 8-in. line to the main of the sprinkler system. A by-pass, connected to a 1,000-gal. Dayton-Dowd centrifugal pump, is provided in this line. The pump, driven by a 100-hp., 220-volt electric motor, will build up the low city pressure to as much as 150 lb. and has a maximum capacity of 1,900 gal. per min. In addition to the pump, a standard Siamese fire department connection is provided just outside the pump room, a 4-in. line connecting it with the 8-in. sprinkler main. This makes it possible to increase the flow of water into the system, over and above the output of the pump, by the attachment of hose lines from one of the city fire engines.

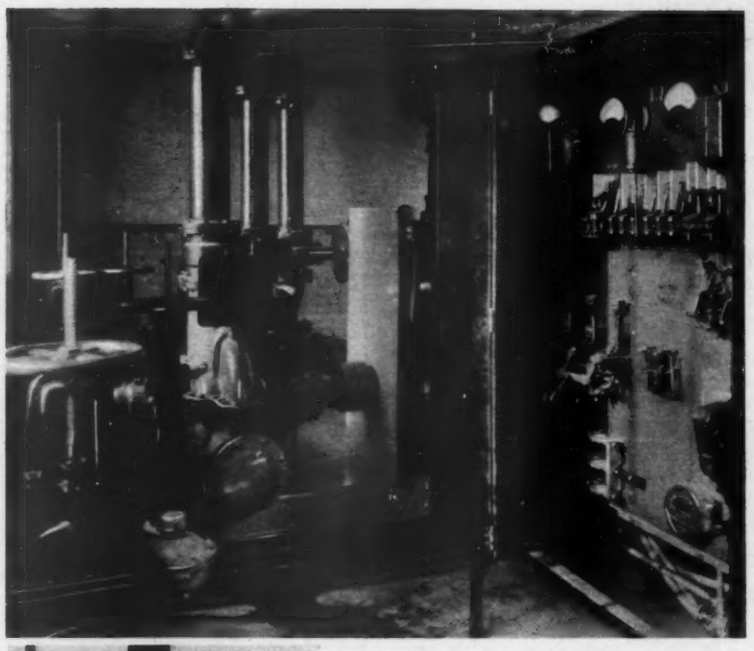
For the purpose of keeping the water in the sprinkler system under constant high pressure, three 4,000-gal. tanks having a single lead into the 8-in. main are mounted above the pump room at the back of the north hangar. Each tank is filled with water to three-quarters of its capacity. This water is maintained under a pressure of 85 lb. The air compressor has been installed in the boiler room.

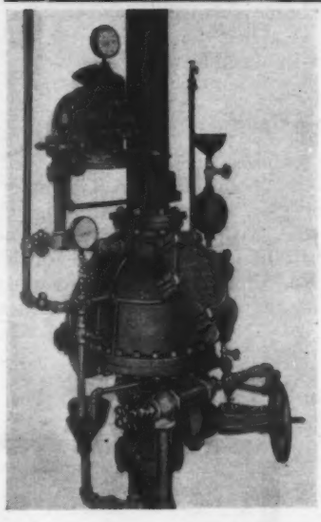
With the opening of one of the sprinkler heads, water is drawn off from the tanks. This continues until the air pressure is reduced to 80 lb., when an automatic switch throws the pump into action. A regulator on the switchboard controls the operation of the pump, so that the pressure maintained in the system is from 80 to 100 lb. This can be raised to 150 lb., the maximum the pump will deliver, by throwing out the regulator through the use of the manual control that has been provided.

One end of the 8-in. main runs from the pump room into the north hangar, where it is joined to the sprinkler supply lines. The other end is carried out underground. It branches after leaving the pump room, a continuation of the 8-in. line taking water into No. 2 hangar, and a 6-in. line carrying it to No. 3. The mains are placed underground to prevent freezing, and also to avoid possible destruction in the event one of the buildings should collapse during a fire.

The dry valves

Because of the construction of the dry valves, 20 lb. of air pressure in the sprinkler lines is sufficient to hold the water in check when the systems in No. 2 and No. 3 hangars are being operated on the dry-pipe principle. The feature of the dry valve is its overbalanced clapper, which flies into the wide open position as soon as the air pressure is reduced enough to permit the slightest seepage of water past the air seat. Yet 10 lb. of air will hold back 60 lb. of water pressure, since the air seat has six times the area of the water seat. It will be seen that the construction of the dry valve eliminates the danger of water columning.





The pump room at the N.A.T. Chicago headquarters, equipped with a Dayton-Dowd centrifugal pump, and electric control panel by the Sundh Electric Company. Right: A Tyden dry valve with exhauster, supplied by the Viking Corporation.

As a means of hastening their operation, the dry valves used in the N.A.T. system are equipped with Tyden valve exhausters. The exhauster is a device to provide an additional avenue of escape for the air in the system when a sprinkler head opens.

One of the features of the device is its automatic shut-off. As soon as the dry valve opens, water is admitted to a small port behind the shut-off diaphragm, which operates two plungers. One of these causes the exhaust valve to return to its seat, while the other closes the shut-off valve, preventing any water from entering the chambers of the exhauster.

To facilitate drainage of the sprinkler lines in the middle and south hangars when changing to the dry pipe system, the horizontal piping is pitched a quarter of an inch in every 10 ft. This precludes the possibility of water becoming trapped in the system, but no matter how carefully the lines are drained, it is impossible to prevent a certain amount of moisture condensation. For this reason, two ¾-in. drum drips are provided in No. 3 hangar and four in No. 2. The drum drips consist of two valves with a chamber between, making it possible to drain the moisture condensing in the systems from time to time with only a negligible loss of air pressure. The drips are installed at the ends of pipe lines dropped down from the roof mains to within a few feet of the floor.

Hose lines

Aside from placing the drains where they are readily accessible, there is another highly important reason for the six pipes brought down from the hangar roofs.

Each line is equipped with a hose connection, 75 ft. of 1½-in. hose, a rack to hold it, and a ⅝-in. nozzle. Two more hose lines, similarly connected to the roof mains, are to be found in the north hangar; but there are no drum

drips below the connections, since the sprinkler system in that structure can be operated only on the wet-pipe principle.

Two wall hydrants furnish a means of attacking a fire in the N.A.T. buildings from the street side. One of these, which has a four-way manifold, has been placed outside the pump room near the fire department connection. Water for this hydrant is obtained directly from the 8-in. sprinkler main, and is controlled by a valve in the pump room. The other hydrant, installed outside the lean-to at the back of No. 3 hangar, takes its water supply from the 6-in. branch of the main before it reaches the dry valve. This hydrant has a two-way manifold and is controlled by a nearby valve. Suitable lengths of 2½-in. standard fire department hose are provided at each of the two hydrants.

Nozzles on roofs

Besides the sprinklers, the wall hydrants, and the fire hose, National Air Transport has a 3-in. monitor nozzle on the roof of each of its hangars. These have been installed to prevent the spreading of fire to the N.A.T. buildings from any of the nearby structures on the field, or from the wooden dwellings across Cicero Avenue and likewise the spread of fire from one hangar roof to another. Capable of throwing their streams a distance of 250 ft., the three nozzles afford the utmost in protection, not only to the N.A.T. hangars but all other structures within range. A 4-in. Siamese hose connection near each of the monitors is also provided. Five hundred feet of 2½-in. hose is kept on the roof of No. 3 hangar for attachment to the connections.

Six-inch lines carry the water directly from the centrifugal booster pump to the monitors and roof hydrants on No. 1 and No. 2 hangars. Shut-off valves for these are to be found in the pump room. The 6-in. supply line for the equipment on the roof of building No. 3, however, is a branch of the line running from the underground main to the wall hydrant at the back of the lean-to. The flow of water in the line is controlled by a valve inside the structure.

The separate shut-off valves allow drainage of the water in the piping to the roof equipment with the advent of cold weather. They also make it possible to stop the flow, preventing a loss of water, should a break occur in one of the lines during a fire.

There are two 40-gal. foam carts provided in each of the smaller hangars and four in the central structure. In addition, a large number of 2½-gal. foam extinguishers and Pyrenes are ranged about the walls. In No. 2 hangar alone, there are 35 pieces of this type of equipment.

A fire alarm system, as complete in every detail as the fire-fighting equipment, is provided at the N.A.T. headquarters. There are but two automatic alarms, however. These are Tyden water motor bells, attached to the dry valves in No. 2 and No. 3 buildings. The opening of a sprinkler head in either one of the structures will cause the bell in that hangar to start operating.

The company employs a night watchman, but a fire originating in No. 2 or No. 3 unit after he had made one of his hourly rounds might gain considerable headway before it was discovered, were it not for the bells.

The fire alarm system is manually operated with the exception of the water motor bells. Push buttons of the ordinary door bell variety are provided at seventeen strategic points in the N.A.T. hangars and their adjoining lean-tos. There is also a push button in the unsprinkled Boeing hangar to the south and the field post office to the north. Each button has its own signal and operates the large 110-volt horns that have been installed in the hangars, as well as a bell mounted on the switchboard in the general offices.

Fire brigade organization

A complete fire brigade has been organized among the N.A.T. employees. Under Mr. Higgins, who is chief, are four assistants. Next in line is the battalion chief in charge of No. 2 and No. 3 hangars. He has one assistant in charge of a crew of six men whose duties are to remove the planes from the hangars. Another assistant is in charge of the two men assigned to each of the chemical carts and hose lines. There is a similar organization in No. 1 hangar, except for a crew detailed to remove planes. It will be remembered that No. 1 unit is occupied by the various overhaul shops.

A third battalion chief is in charge of the 2½-in. hose lines and the monitor nozzles on the roofs. Like the battalion chief in the north hangar, he has one assistant. Under these two are nineteen men assigned to the hose lines and hydrants on the street side of the buildings, three men detailed to operate the monitor nozzles, and five men to handle the 500-ft. hose line on the roof.

In view of the smaller force available at night, Mr. Higgins has appointed but one battalion chief in the evening crew and one in the morning.

National Air Transport holds fire drill at its Chicago headquarters regularly once every two weeks; it tests the horns in the hangars and the siren on the roof at noon every day; the centrifugal booster pump is turned over once every two days; the Pyrenes are dumped and refilled every six months, and the foam extinguishers every year; the entire system is inspected every 60 days by the insurance company.

It is surprising that more transport lines, faced with the necessity of paring down expenses, have not taken advantage of this method of reducing fire risks and cutting costs.

A card for production control

IN ORDER to maintain an instantly readable record of the production of the 1,500 parts entering into the construction of Boeing airplanes, the accompanying card has been developed. At the end of each day the work completed by the various shops is checked by the inspection department and the shop report forwarded to the production office, where it is recorded for quick reference on these 2x8-in. cards devised to fit into an I.V.I. file made by the Remington-Rand Company.

The left side of the card is devoted to part number, part name and quantity, while the right hand side records the various shops, designated by letters, through which the part is to pass. Each of the ten sub-divisions above each shop letter is filled in with red pencil when one tenth of the total number of parts of the entire lot has been completed.

By this method an instantaneous picture of production progress is available at all times.

Some recommended practises for the maintenance of this highly important equipment

Inflating shock absorber struts

Servicing shock absorber struts

By

Louis F. Ross

Cleveland Pneumatic Tool Company

SHOCK absorbers are installed on airplanes for long life, economy, safety and comfort of pilot and passengers. The most important of course, is economy, since the jolts and jars of ground movements wrack plane and engine, weakening and damaging sensitive parts of the engine and fuselage, increasing maintenance expense and hastening deterioration.

Shock absorbers are so frankly recognized as necessities by the designer, engineer, operating company and pilot that virtually all heavier-than-air craft as well as some classes of rigid and semi-rigid dirigibles are equipped with them.

The oleo-pneumatic, using a combination of compressed air and oil has been found to be effective for shock-absorption. Others have their particular and distinct advantages, the chief of which is lower first cost. Rubber shock cord deteriorates with age, becoming brittle and hard and losing its resiliency until it breaks and must be renewed. It becomes soft and rots where it is subjected to constant oil spill from engines, and becomes less and less effective as its life limit is reached. A unit, involving the use of oleo and rubber, takes the impact through hydraulic action similar to the oleo-spring type of strut. None of these types, however, with the exception of the oleo-pneumatic has any form of rebound control.

Construction of the strut

The parts that comprise an Aerol oleo-pneumatic strut are (the figures refer to the accompanying chart): an alloy nickel steel cylinder (1) to which is attached a primer plug (11), a specially constructed Schrader Hi-pressure valve (10), a valve stem (8), plug and dust cap (12), and the lower piston tube to which is attached the piston head (2) and the recoil valve. In addition there are the packing seat (3), packing (4), packing gland (6) and packing gland lock nut (5).

The cylinder and piston tube, which constitute the principal working parts of the strut, are made of alloy steel common to aircraft practice, and are heat treated to the proper temperature in electrically-operated and automatically controlled furnaces to insure a minimum tensile strength of approximately 125,000 lb. per sq.in.

The lower tube is chrome-plated to insure long wear and resist corrosion. The piston head is made of bearing bronze and the recoil valve is made of steel.

Connecting ends by which the struts are attached or connected to the aircraft are made from nickel steel and are also heat treated to insure sufficient tensile strength and eliminate any possibilities of breakage during service. Other component parts are constructed from materials adapted for their particular use.

Frequent and close inspection is given each part of the struts for which tolerances ranging from .001 to .0005 in. must be maintained and held. Periodically complete orders of work are sent to the inspection department for a more thorough examination. After the last operation, all parts of the struts are sent to the inspection department for final examination being placed in the assembly line or the storeroom for finished products.

Assembling and testing

The lower tube is inserted in the cylinder and is followed by the packing seat to allow the packing to rest on the packing gland nut which is screwed into the packing housing. The latter is a part of the cylinder. Then the gland is locked with a lock nut.

While the cylinder is totally collapsed, it is filled with a specially compounded oil to allow for operation of the strut in low temperatures. It is then inflated and tested.

After testing the strut goes to the

paint shop where two coats of navy gray paint are applied, and the name plate put on.

The struts are tested after assembly by machines which subject each unit to practically the same conditions that it is to receive in use on aircraft. In the drop test weights equivalent to the weight of the plane are dropped on the struts to insure its ability to support the static load. The operating test is so arranged that the piston of the strut works up and down against the cushion of air and oil inside the cylinder, producing the same effect as the plane in its take-offs, landings and taxiing.

Operation

When the piston is fully extended, which corresponds to the "in flight" position, there is a provision for it to travel 8 in., the distance between the red line on the piston to the packing gland, located at the end of the cylinder. There is a head of oil, 3 in. in depth, which seals the piston and above that 5 in. of air plus the air in the compression chamber. The air is under pressure of about 200 lb. per sq.in. which varies according to the static load of the shock absorbing unit.

As the wheels of the airplane touch the ground the piston tube is compressed, building up pressure depending on the force of the impact. The compression of air thus absorbs the shock.

When the piston compresses the air, part of the oil above the piston head is transferred through the head of the piston and between the cylinder and the outside of the piston tube into the chamber below.

When the pressure has been built up within the cylinder in excess of the static load requirements of the plane there is a tendency to rebound, but, as the piston begins to extend, the oil trapped below the piston head in the chamber closes the recoil valve which forces the oil to return through a predetermined orifice, to its normal position above the piston head, thus controling the rebound.

Inflation

Inflation of the struts is an operation which, though simple, must be done correctly. This involves only the removal of the dust cap on the air valve, the removal of the knurled cap and the attaching of the special air hose. Struts should be inflated until the red line or the end of the piston bearing is from 3 to 6 in. below the packing gland nut, depending on the pilot's requirements.

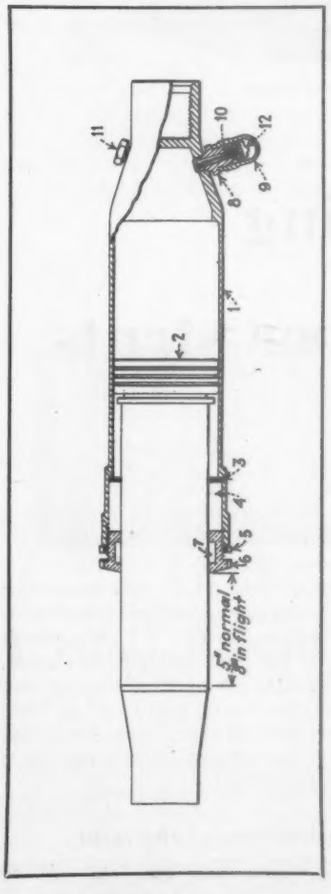
For landings under ideal conditions the struts could be inflated until the bearing is about 4 in. below the packing gland while those involved in student training or putting down on unfavorable airports would require this setting at 6 in. below the packing gland.

It is advisable to roll the airplane forward and backward a few inches several times during the inflation to allow the wheels to take their normal alignment which should be done while the plane is standing evenly on the ground. If one wheel is resting on a ramp or apron and the other on lower ground, the inflation is certain to be uneven. If the tail is up on a dolly the amount of inflation given the struts will not represent that required by the load of the plane when in static position.

After making certain that equal and correct air inflation has been given each strut, the operator has only to replace the knurled valve stem cap, tightening it with his fingers to prevent any leakage and then replace the dust cap to protect the valve stem. It is inadvisable to use a wrench in tightening the cap.

Under ordinary operating conditions oleo-pneumatic struts require neither time nor attention by the operator. Even the simple operation of checking the air adjustment is not necessary nearly as often as most operators suppose. The position and the load of the airplane sometimes makes it appear that the air pressure is down and that the struts require inflation, but before reinflating several points should be checked: (1) that a variation of more than a quarter inch is to be seen; (2) that the plane has the same load as it did when the struts were originally inflated, since a variation in load will make a difference in the position of the strut piston and make it appear high or low; and, (3) that the plane is in the same relative position as it was when the initial inflation was made and declared correct.

Most wheels on aircraft have a certain amount of toe-in. Consequently if the inflation is checked after the airplane is rolled backward into the hangar, the extension will check shorter than on rolling forward as this movement puts the strut under compression. This is true on all types of aircraft where the wheels are toed-in.



The Aerol strut: (1) upper cylinder, (2) piston tube assembly, (3) upper packing follower, (4) special gland packing, (5) gland lock nut, (6) packing gland nut, (7) felt wiper ring, (8) air valve body, (9) air valve dust cap, (10) air valve insides, (11) primer plug, (12) valve cap.

Maintenance notes

The only two things that can happen to oleo-pneumatic struts are: first, leaking air through the valve, second, leaking oil. The loss of air will let the strut go flat which in itself will not harm it if not repeatedly landed on in this condition. The second is equivalent to losing air as it increases the size of the air chamber. This condition is comparatively rare and, as a rule, does not require immediate attention.

Air leakage may be easily corrected by checking the valve insides (just as in the case of a pneumatic tire). If tightening up the valve insides does not stop the leakage, the valve itself should be screwed out and replaced with a new one.

Oil leakage can be remedied in most cases by tightening up the low gland nut while the strut is deflated. This may be done with a spanner wrench or other suitable tool. Care should be taken not to damage the gland nut. Taking up in the lower gland almost invariably stops the oil leakage. Should it not, however, it is an indication that the packing should be renewed. Should oil leakage show around the packing gland, the locking ring should be loosened and the gland nut tightened just sufficiently to check leakage. Then the gland nut should be locked with the lock ring to prevent loosening.

To refill the oleo-pneumatic strut with oil, the strut should be completely deflated by depressing the air valve, allowing all air to escape and the strut to telescope to its shortest length. The valve and primer plug should be removed and the cylinder filled with the special strut oil until the oil runs out of the valve stem. This oil has a low cold test making it unnecessary to change oils for varying climatic conditions. The primer plug and valve can then be replaced and tightened securely with a wrench to prevent leakage, and the strut is then ready for inflation.

Single or twin-engined day bombers?

Major Stewart starts a discussion

In AVIATION for June appeared an article by Major Oliver Stewart, late of the Royal Air Force, commenting upon the relative merits of bombing planes with an engine on each wing and bombing planes with an engine in the nose. The questions that were raised are of great importance. They deserve careful reflection and discussion, not only by military men but by everyone in the aircraft industry who is interested in a military market for his product. To keep the matter alive before the industry, and to develop American points of view to set beside that which Major Stewart brought from a British background, we have solicited the views of a number of present and former officers of the Army and Navy and designers of military airplanes. The interest of the subject is attested by the generosity with which they have responded and by the care and thought that their answers display. It is a privilege to set before our readers a symposium with such distinguished participants. ¶ By immemorial rule, the man who has the first word in a debate is given the opportunity of the last one as well. Save in a few cases where time was lacking, copies of the comments received were forwarded to Major Stewart. His amplification of his original remarks is included in these pages.

Major Herbert A. Dargue

Air Corps; Commander of the Second Bombardment Group based on Langley Field; Commander of the Air Corps flight around South America in 1927; Especially active in the development of bombing equipment and methods during the past three years.

MAJOR Oliver Stewart's article deals with the problem in the simplest terms and I hesitate to offer any criticism which involves more intricate factors.

The day bomber's most desirable characteristics appear to be range, load and speed, but these may vary greatly in relative importance in different theaters of war, and according to missions desired to be performed. Geographical location of a belligerent may have a decided influence, therefore, what may be determined as best for one nation may be rejected by another.

The single-engined day bomber can undoubtedly be developed to give nearly all the desirable characteristics of the twin-engined bomber except load carrying ability. As higher powered engines come into general use probably the maximum load desirable for one bomber to carry can be met. After all, we do not want to put all our eggs in one basket.

In all the new bombers now under construction the monoplane design is replacing the biplane. In this construction it has developed that arrangements can be made for ample defense, both when a monoplane is equipped with two engines or with an engine in the nose. Incidentally, the tri-engined bomber has made its appearance and initial tests indicate that it will probably give as satisfactory performance as the single-engine or twin-engine types. A multiplicity of engines, however, increases the chances of engine failure and greatly increases the number of instruments, throttles and other gadgets about the plane. All of which, of course, increases the chances of failures.

H. A. Dargue

The point is well made that a day bomber is not designed for offensive work against other airplanes in the air, therefore, its defensive characteristics might be considered secondary to speed and load. With the increasing speeds of bombers the difficulty of interception by enemy aircraft is very materially increased, and if day bombers can operate in very high altitudes possibly the greatest defense is then obtained through this speed and altitude rather than through defensive armament.

The question then seems to resolve itself largely into whether the better performance in speed, load and range (though this last factor may not be so important in the case of certain belligerents) is obtained from the single-engined plane or the multi-engined plane.

Simplicity of equipment is desirable, reliability is imperative; other factors depend somewhat upon the conditions to be met in the particular case confronting the country for whom the aircraft is provided. The great advances from speeds in the neighborhood of 100 m.p.h. to almost twice that speed in recent developments is so great that it appears much use of the equipment in the air and a great deal of further study will be necessary before definite decision can be made favoring one type above the other for day bombardment work. Experience so far seems to place the balance in favor of the twin-engined airplane, but with increasing efficiency of power plants and the airplane itself and with a consideration of the specific use to which these planes are to be put, it is highly probable that single-engined day bombers will fill all requirements in a few years to come.

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Lt. Comdr. Forrest Sherman

U.S.N.; Gunnery and Tactical Officer on the staff of the Commander of the Battle Fleet's aircraft force; A frequent contributor of studies on air tactics in professional naval journals.

MAJOR Stewart, in his very interesting article on day bombers, has very ably compared the tactical qualities of single-engined and twin-engined day bombers. He has argued that the higher speed and performance of the single-engined plane is more valuable as a means of defense than is the greater gun power of the twin-engined plane. His conclusion is that this difference is great enough to outweigh the increased accuracy obtainable from the steadier bombing platform of the twin-engined plane.

It is interesting to turn to the most recent edition of Jane's "All the World's Aircraft" and note that the Royal Air Force of Great Britain shows all day bombing squadrons equipped with single-engined aircraft such as the Fairey Fox, the Hawker Hart and Horsley, and the Westland Wapiti, except for one squadron equipped with the twin-engined Boulton and Paul Sidestrand. Furthermore the

Forrest Sherman

Fleet Air Arm is listed with no twin-engined bombers but is credited with many single-engined aircraft of the day bomber type, Fairey III F's in Fleet Spotter Reconaissance units, and with single-engined Hawker Horsley's, and Blackburn Darts and Ripons in torpedo and bombing units.

The reasons for this preponderant use of single-engined aircraft are many. Their superior speed and performance recommend them. They have greater power of maneuver and are generally smaller and handier. Moreover, some of the arguments in favor of the twin-engined craft do not bear analysis. For instance it is well known that, illogical as it may seem at first thought, it is easier to surprise a multi-seater than a single-seater—easier to surprise a flight than a single plane. Carrying extra personnel does not ensure against surprise attacks.

It is true that a plane such as the Sidestrand carries three free-gun mounts, but when the weight of three gunners with their armament is figured in with the necessary weight of the pilot, bomber, and radioman, the inferior performance of the plane becomes even less. Or, if the bomber or radioman have to man the guns, the bombing efficiency is thereby lessened. The great differences in gun power and in arcs of gunfire shown by Major Stewart in the case of the single plane tend to disappear in the case of formations where the guns of one plane can cover the blind spots of its neighbor.

From the purely naval point of view it is obvious that a twin-engined plane is larger, harder to handle and stow on board ship, and in addition has many added difficulties in deck landing work.

Most important of all, however, is the speed difference between the two types. It is difficult to sufficiently emphasize the value of speed to any airplane which, although of inferior fighting characteristics, must during daylight traverse areas where it is subject to fighting plane attack. It must depend largely on its own speed for its ability to reach an objective before being intercepted and also for its ability to safely withdraw. The use of slow, and therefore vulnerable, units for any attack purpose creates a necessity for attaching strong protective and supporting forces, and reduces the forces available for other offensive purposes. From such considerations we derive the principle that equipment with relatively slow planes automatically tends toward placing an air force on the tactical defensive. Hence the constant demand for speed even for bombardment units.

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Major Leslie MacDill

Air Corps; Now member of the Plans Division in the office of the Chief of Air Corps; Lately chief of the Experimental Engineering Sections, Wright Field, and later chief of the Procurement Section at Wright Field, supervising trial of all new Air Corps equipment.

I THINK Major Stewart has written a very interesting article and has covered most of the points. I was very much surprised, however, when I read the last paragraph of his article containing his conclusions. The argument up to that point had led me to believe that his conclusion would be the direct opposite. Major Stewart is evidently of the opinion that multi-engined bombardment cannot protect itself against

C. T. Porter

pursuit, which conclusion I believe to be correct when applied to a single airplane but incorrect when applied to a formation of bombing airplanes. since a formation of bombing airplanes, because of their mutual support, is a great deal stronger than the same number of individual planes.

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C. T. Porter

Chief engineer of the Keystone Aircraft Corporation, builders of many bombers, both twin-engined and single-engined, over the last eight years.

MAJOR Stewart's article has covered the field with exceptional clarity. I believe there is very little to add.

The problem of the military effectiveness of the single versus the twin-engine bomber seems to hinge entirely on the relative defensive power of the two types. It is obvious that the single-engine bomber will have a better performance, and hence when using this type of plane the probability of encountering enemy pursuit will be somewhat lessened. However, no matter how greatly the performance of the single-engine bomber is improved it will always be possible to build a pursuit plane that will have superior speed and climb. If we start with this fact established, we must then also grant that an encounter between bombers and pursuit will be inevitable. Since this is so, the bomber with the best defensive protection should be the superior type, provided of course that the defense is effective.

Major Stewart raises the very interesting question as to the relative effectiveness of a gun fire from a pursuit plane as compared to the flexible guns of the bombers. It would seem that in this controversy the bombardment people are confident of their ability to defend themselves against pursuit attack, while the pursuit pilots are equally confident of their ability to shoot down bombardment. It would seem to the writer that a pursuit pilot protected by a radial engine and with very little of his person exposed to the direct fire of the rear gunner in a bombing plane would be a very dangerous antagonist. However, there is no way of proving the relative offensive power of the two contestants except by actual combat.

In reviewing Major Stewart's article the writer would like to take exception to the sketches showing the field of fire of the single and the twin-engine bomber. In both cases the upper rear gun is shown as covering a segment of the upper hemisphere only, while this gun is actually designed for vertical fire downward over the side. In addition to this, the single-engine bomber can be equipped with a floor gun as was the case in the writer's design of the LB-1 type. It would seem, therefore, that the main advantage of the twin-engine as compared with the single-engine bomber consists in the forward protection accorded to the former type. Single-engine bombers have been built with fixed guns, but it is generally conceded that this gun has little value and is useful only for its psychological effect.

To sum up the foregoing, the writer believes that the superior advantage of the twin-engine type of plane is pretty well established and with modern development tending toward very high speed it may be possible to develop a twin-engine plane with a performance combarable to that of the single-engine type, especially if we are confined to the power plants as now developed. For example, a twin-engine plane employing two of the largest power units now developed should be more formidable than a single-engine type which would be limited to one-half the power. When engines of greater horsepower are developed the situation may change.

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Lessiter C. Milburn

Vice-president and chief engineer of the Glenn L. Martin Company, builders of the standard Army bombers for five years immediately following the War, and of many experimental and service bombing types for the Navy since 1926.

THE Martin Company has studied the military bomber airplane continuously for fourteen years, and I suppose I should feel no hesitation in commenting on the problem. Nevertheless, I can only speak from the designer's viewpoint.

In this country certain facts speak for themselves. For several years after the war the Army Air Corps was definitely committed to the twin-engined type. A little later various experimental single-engined bombers were built and after thorough investigation were discarded. We find the Air Corps at the present moment confining its attention entirely to the twin-engined type.

Naval aviation has very thoroughly investigated the merits of both single and twin-engined types and while the single-engined type is at present the standard Navy "bomb-sight bomber" this is more necessity than preference, due to limitations of space and other difficulties of operation aboard aircraft carriers. Personally I feel that the fundamental requirement is the bomber's cockpit, its facilities for bombsight vision and operation of bombing controls to determine the efficiency of the airplane as an instrument of ordnance. The bomber must

Lessiter C. Milburn

be well placed and comfortable which is practically impossible in the ordinary single-engined bomber. It appears to me that this predominating requirement dictates the selection of the twin-engined airplane for bombing purposes.

As to performance and gun protection there appears to be no fundamental reason why the twin cannot deliver as good or better than the single-engined airplane particularly after account is taken of the fact that parasite resistance of the single-engined airplane is materially increased when effort is made to provide a bomber's cockpit comparable in operating efficiency to the bomber's cockpit in the twin.

Efforts to provide forward gun protection in the single-engined bomber have not met with success, whereas in the twin-engined type, forward gun protection is readily obtainable and, by the use of suitable gun mounts, obtainable without excessive increase in parasite drag.

In expressing my views as outlined above I have in mind the bomber of 1,200-lb. to 2,000-lb. bomb load and in this class the maneuverability of the single-engined type is not greatly superior to the twin of good design, nor do I believe maneuverability to be of paramount importance because the maneuverability of the attacking forces will usually be far superior to either type.

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Bruce G. Leighton

Vice-president of Curtiss Aeroplane & Motor Company; Formerly Lieutenant Commander, U.S.N.; Chief of Planning Division, Bureau of Aeronautics, in 1927 and 1928; Particularly active in the development of bombing tactics and (some years earlier, when in charge of the Power Plant Division) in the introduction of radial air-cooled engines into the naval service.

MAJOR Stewart's article, "Single or twin-engined day bombers?", boiled down to its essentials, says in effect:

I. The twin-engine bomber is a steadier bomb platform and will make more hits. If it is forced to fight during its approach to objective, it can do so with some measure of success at the same time that it carries on with its *bombing* mission. In other words, its *offensive* qualities are distinctly superior, but it is more likely to be shot down on its way home.

II. The single-engine bomber is not so good a bomb platform; it will make less effective bomb hits even when unopposed, and if forced to fight on its way to the objective it cannot do so while still carrying on with its *bombing* mission. In other words, its *offensive* qualities are distinctly inferior, but it runs a smaller chance of being shot down on its way home.

III. Offensive qualities are less important than defensive qualities.

IV. "Therefore, the day bomber should still pay more attention to aerodynamic qualities than to military qualities."

The first two premises appear to have been established by actual service experience both here and abroad, that is, so far as existing machines are concerned, and so far as the problem is related to normal horizontal bombing, as distinct from dive bombing used so extensively in the naval service in this country.

As for the third premise, I believe that Major Stewart will find few supporters among close students of tactics. To place defensive qualities ahead of offensive qualities in any military weapon is a reversal of all experience in war.

My own personal views in the matter might be expressed somewhat as follows: (I emphasize that I am speaking purely of conventional horizontal bombing.)

I. Offensive qualities in a bomber are paramount. Existing twin-engine bombers have demonstrated superior offensive qualities, and therefore are preferable to single-engine planes, notwithstanding that they are at present inferior in speed, more costly to build, and require more men to operate.

II. Multiple-engine planes in large sizes are not *inherently* slower than single-engine planes to the degree indicated by actual performance of existing models. The present discrepancy in speed will be less evident in future designs as larger power units are used and limiting propeller tip speeds become a more important factor. Existing single-engine bombers are faster largely because more attention is paid to speed in their initial design—as the sole excuse for their existence.

Ernest W. Dichman

III. Future development in bombers will probably trend more and more strongly toward multiple-engine designs, and must, in recognition of the need for better protection, place more emphasis on speed, maneuverability, and aerodynamic efficiency than has been the accepted mode in the past.

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Ernest W. Dichman

Chief engineer of the airplane division of the American Airplane and Engine Corporation (formerly Fairchild Airplane Manufacturing Corporation) and lately of the Air Corps; Major in the Air Corps Reserve; For several years up to 1929, chief of the Airplane Design Section at Wright Field, devoting special attention to the development of bombardment and transport airplanes.

NO one will deny Major Stewart that the perfect military aircraft is the one in which the balance between aerodynamic and military qualities has been correctly struck. However, the arrival at this perfect balance when and if obtained is something which can only be determined in actual warfare. So many variables beside the design of the particular military airplane enter into the problem. Our goal is constantly shifting so that an airplane which could be considered ideal under one set of circumstances might be of inferior military value under changed conditions.

The mission of a bombardment airplane is to drop its bombs upon a predetermined objective and return to its base if possible. The cost must be reckoned before ordering the mission. In some cases this objective must be destroyed regardless of cost. The problem then is to select the airplane or group of airplanes which can most effectively deliver the largest load of explosives on a point and return to its base.

To make the problem specific consider high altitude day bombardment aviation against an enemy with a comparatively well equipped air force. I cannot agree with Major Stewart that aerodynamic considerations should outweigh the military. For a bomber to outdistance a pursuit airplane indicates to my mind something wrong with the design of pursuit assigned the duty of harassing enemy bombardment. If by refinement of design the speed of bombardment airplanes is increased 20 m.p.h., an equal effort on refinement of pursuit design should result in an increase of 30 m.p.h. I am therefore in favor of the twin-engined bomber and for the following reasons.

In my opinion the most important element in bombardment aviation is accuracy of sighting. It is of small avail to carry a ton of explosives on a perilous journey of 200 miles or more and then miss the target. As a matter of cold facts, the destruction of the objective may be worth the loss of several airplanes.

Next in importance comes the load of bombs carried. To destroy an important objective the bombardment must have force and power. This means heavy bomb loads per airplane.

Last in importance comes defense against enemy aircraft. In this connection it should be noted that the defensive fire power from the formation rather than from the individual airplane should be considered. There undoubtedly will be occasions where the lone bombardment airplane will be caught and have to put up a defensive battle alone but such instances should not unduly influence the design to the prejudice of its military usefulness.

Nothing in the foregoing paragraphs should be interpreted as minimizing the importance of speed. Speed should be as high as possible consistent with the load, service ceiling, and landing speed desired. However, I cannot subscribe to the opinion that bombardment airplanes can depend upon speed for evading enemy pursuit at the sacrifice of certain vital military features.

In addition to being twin-engined, the airplane should be capable of flight on one engine with the bomb load and approximately one-half of the fuel load dropped. This should be quite possible of attainment if it is considered in the basic design.

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In addition to the letters published above, we have received from another very competent source the following analysis of some of Major Stewart's points.

I AM convinced in my own mind that accurate bombing from single-engine tractor aircraft will not be possible for many years to come . . . From my own personal experience I do not think it is feasible for a bomber to bomb effectively from a prone position . . . A bomber must be comfortable and well-protected from windblast in order to bomb effectively. This is particularly important when high altitude bombing is to be attempted and the bomber must wear heavy clothing and possibly use oxygen as well. In my opinion, therefore, the twin-engine bomber is far superior to the single-engine tractor bomber, as the twin engines permit an arrangement affording a well enclosed, roomy, and convenient cockpit with ample visibility forward.

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When one comes to the question of self-protection I also believe the twin-engine bomber far more efficient. The problem of forward protection for our single-engine bombers is today most acute.

I agree with Major Stewart that recent experiments point to greater gun accuracy with flexible guns than with the fixed guns of the single-seater fighters, although, as he points out, this is contrary to opinions that have been passed down to us from the War. I am beginning to believe, however, that many of the so-called war opinions and experiences have either become distorted as the years have gone by or that aviation activity has so changed as to entitle them to but little weight at this time. In any event, my opinion is that the flexible gun of a bomber will at least be the equal of the fixed gun of a fighter. I will go even further and say that a compact formation of bombers with flexible guns fore and aft will be a most difficult proposition for single-seat fighters.

I cannot agree with Major Stewart that the engine serves as an impenetrable shield for the pilot of a single seater. Unquestionably a .50 caliber bullet will plow through any air-cooled cylinder. Whether a .30 caliber or .50 caliber hole in an engine cylinder will cause fire has not been determined, but it certainly seems possible. As for armor or shields on airplanes of any type, . . . I am personally convinced that armor of any value will be so heavy as to be out of the question.

As Major Stewart's plea for the single-engine bomber is based solely on the opinion that any protective machine gun fire is inadequate, you will see that I do not agree with him. As for his contention that its defense should be its ability to run away due to its aerodynamic qualities, I most certainly disagree with him. No bombing mission should be undertaken if it is necessary to run away from the first aerial opposition that is encountered. Our bombers must be prepared to fight their way through to the accomplishment of their bombing mission.

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Major G. E. Brower

Air Corps; Commanding the First Pursuit Group; Formerly chief of the Airplane Section at Wright Field.

AS a starting point, it is necessary to define more specifically what is meant by a day bomber. The British day bombers appear to be quite close in type to our two-seater pursuit planes, whereas our day bombers carry twice the bomb load and are required to have possibly twice the range of the British type.

Major Stewart reduces the entire question to the comparative effectiveness of fixed versus flexible gun fire. Recent tests on the West Coast in our Air Corps appear to support Major Stewart's opinion that the fixed gun fire is more effective at present.

From the purely engineering standpoint the single-engined plane will undoutedly have greater speed and greater range for a given bomb load and horsepower. Practically, however, the twin-engined will usually have more power (of course, at the sacrifice of larger size, increased fuel load, and greater cost) and the result is that the speed differential is not great. The 20 m.p.h. set up by Major Stewart is rather high. It is doubtful that the single-engined bomber will ever be so much faster than the twin-engined bomber that its ability to evade attack will be noticeably better. The advantages of vision and accommodation for the bomber, and of practically unblanketed field of fire (so that day bombers used in formations can maintain a given course without having to maneuver in defense) pointed out by Major Stewart are obviously of great value.

From a tactical standpoint pursuit organizations will find it much more difficult to bring down the twin-engined day bomber types than the corresponding single-engined bombers designed to the American specifications. Equipping pursuit with radio makes it possible to intercept hostile bombardment formations with pursuit which is already in the air or on the alert, so that small advantages in speed of one type of bomber over the other will be much less important than when vision alone controlled the interceptions.

In conclusion, it would appear that when day bombing is to be done by small, fast two-seaters carrying not over a 500-lb. bomb for a short range, then the single-engine arrangement is preferable. When the bomb load is as much as 1,100 lb., then effective sighting becomes more important, the speed differential between the bomber and pursuit types is so much greater than the speed difference between the two bomber types, and the combat maneuverability of a single-engined bomber of this size is so low, that the twin-engine arrangement should be adopted.

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Major Stewart replies

Major Oliver Stewart

FROM the comments that have been made, both in America and in England, upon my analysis of the military value of the single and twin-engined day bomber it seems that instructed opinion is moving towards the twin-engined machine as being the superior.

That there is wide scope for the twin-engined day bomber I have never doubted; but I deprecate the tendency to assume that one moveable gun in a multi-engined day bomber is the equal or the superior of one fixed gun in the single-seater fighter and to base excessive claims for the twin-engined on that ground.

Major Leslie MacDill mentions the influence which formation flying has upon the powers of defense of the twin-engined aircraft. It is true that the result of an air combat is never decided by so simple a process as that of balancing the qualities of individual aircraft against each other. But for the present discussion, one twin-engined or single-engined day bomber must be placed against one fighter. And in fact the belief that the formation is better than the sum of its constituents is open to question. The formation is discovered more readily and the attackers, by employing converging dives or other suitable systems of attack, will ensure that the gunners of the formation are unable to concentrate their fire on any of the attackers.

Mr. C. T. Porter mentions his LB-1 which was equipped with a floor gun. I do not know this type but I presume that its crew includes only a single gunner. The gunner therefore has two guns to operate from two different positions. In practice it would be found that one gun would be useless. One of the proven methods of attacking a plane with a movable rear gun is to make a feint approach from one side and then to make the actual attack from the other. It is found that the gunner is often unable to swing his gun in time to do any accurate shooting. Clearly one gun in one position is the most that one gunner can manage. If two gunners are used the performance falls and unless the single-engined machine has high performance it is useless.

The views of Mr. E. W. Dichman and of Mr. Bruce G. Leighton are supported by extremely ingenious arguments in favour of the twin-engined machine. I think that Mr. Dichman pays too little attention to powers of defense. Supply in time of war would be a decisive factor and would be linked up with the defensive powers of the aircraft. No air force could afford the lavish expenditure of men and machines which Mr. Dichman suggests might be warranted.

Mr. Leighton goes to the root of the matter when he says that "multiple-engine planes in large sizes are not inherently slower than single-engine planes to the degree indicated by actual performance of existing models." If the twin-engine plane designer can, as one British designer assures me will soon be possible, produce aircraft which are only perhaps 5 or 10 m.p.h. slower than corresponding single-engined machines, then the twin-engined day bomber must definitely be given the advantage. In fact the relative superiority of the two types is as much dependent upon the difference in performance between them as upon anything else.

Commander Sherman pins down the essential points so far as Naval equipment is concerned when he mentions the additional complications in handling and stowing introduced when the larger twin-engined types are employed. But a point in favor of the twin-engined machine in Naval equipment of which he omits to take note is its versatility. It can turn to a much greater variety of tasks than the single-engined machine.

The anonymous correspondent raises an important question when he doubts the capacity of an air-cooled engine to act as an effective shield against machine gun fire. Certainly air-cooled rotary engines have acted as effective shields on many occasions; but whether a radial would do so is a matter which ought to be made the subject of trial.

A laboratory at Miami insures fuel quality for a vast air route over country with no unified supply system

Where fuel distribution becomes a major problem

REFUELING transport planes in the tropics is apt to involve such unexpected difficulties as mooring a flying boat to a river barge when there is a 15-knot current running against a stiff wind. In addition, there are primary problems of fuel supply. Gasoline deteriorates, as it does in temporate climates, and must be subjected to frequent laboratory tests. But laboratories are not always handy at isolated points along the beach. Altogether, fueling becomes a matter sufficiently difficult to make interesting a recital of some of the practices adopted by Pan American Airways.

Dirt and water are gas problems in the tropics. They can be met, as they are met in normal operations here. Such losses are not frequent once a station is properly organized under the control of its field manager.

Static and fire hazards are similar everywhere. But native labor may make them more dangerous. Static is largely eliminated as a danger source by electrically bonding the entire fueling system from the gasoline container to the plane's frame. Where hand pumps are used to pump from drums, they are of brass so that steel does not strike steel with a resulting spark.

In general, gasoline cost averages about 35 cents a gallon through the tropics. This is high. Bulk shipments, where possible, reduce costs a little and improved conditions are expected in the future as the number of automobiles increases and better storage and shipping facilities are justified.

Air transport operations through country where there is no developed gasoline supply system mean that a special distribution plan must be effected which will maintain adequate supplies at widely scattered places in the face of a relatively small consumption of fuel per station.

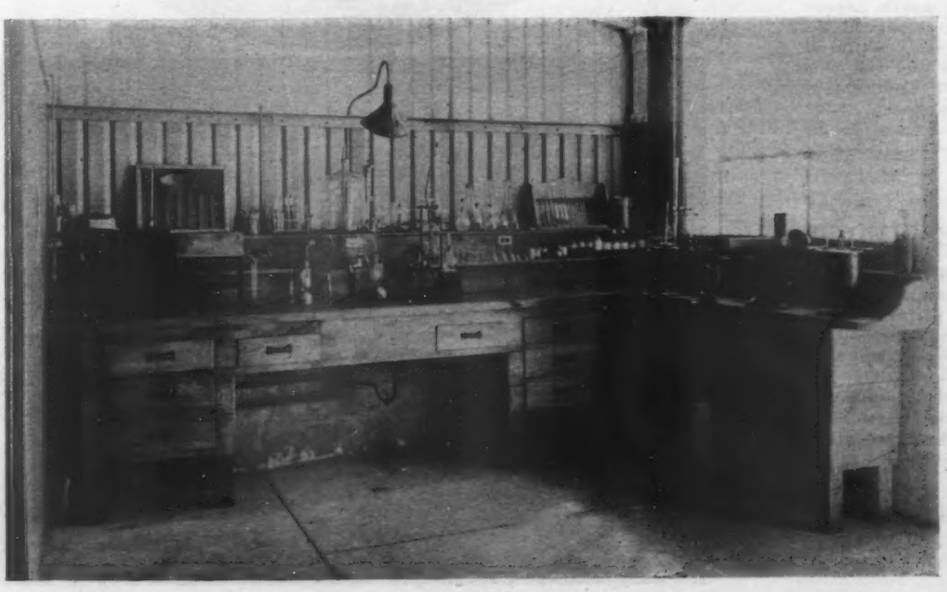
Periodic laboratory tests

The distribution problem may call for larger supplies of delivered gasoline than a similar base in the North would demand. Thus chemical deterioration and "weathering" are more likely to be met. Pan American Airways has maintained its own testing laboratory at Miami. Samples of gasoline are taken periodically from supplies at various bases, and sent to Miami by the company planes. There they are tested and bad gasoline is not allowed to go to the airplane engines. Besides the laboratory equipment, Pan American now has a Ricardo knock-rating engine. Thus making it possible to specify fuels for anti-knock quality as well as for distillation curve and for chemical properties, protects against certain over-heating effects of unsuitable fuel and against the elusive "detonation."

About 12.6 per cent of the gasoline stored for use in the tropics has to be rejected because of deterioration. When deteriorated fuel is discovered it is turned back to the fuel company and used for automobile or other engines, where the deterioration is not of the consequence it would be in aircraft operations. The loss from deterioration is seen to be comparatively high. Loss from wastage, dirt, spilling, etc., totals about 4 per cent.

The customer does not pay for gasoline until it is poured into the funnel on top of the airplane gas tank. The stored barrels of gasoline at the various fields belong to the oil company. Although at fixed bases the tank storage method has certain advantages, barrels have their good points. They are easily handled and checked and offer a more flexible supply control.

Gasoline equipment in the tropics presents another difficult problem for the reason that the oil company must estimate the chances of any particular field remaining a regular base for aircraft. Unsettled political conditions also create hesitation about too expensive installations.



View of the Pan American fuel testing laboratory at Miami.

BIRMINGHAM

Birmingham, Ala., began construction of a $1,000,000 municipal airport early last year and the new plant was dedicated May 30-June 1. Its 315 acres are artificially drained and of turf, with the exception of a 3,600x100-ft. runway of coarse aggregate asphaltic concrete on a brushed stone and slag base. Two buildings have been erected. One is a large white brick administration building of Colonial design, the other a 150x120-ft. brick and steel hangar. The tract is about five miles from the post office, approximately a twenty-minute drive from the city. Steadham Acker is the manager.

Three outstanding new airports

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RENTSCHLER

The new 165-acre all-way turf airport at East Hartford, Conn., was dedicated Rentschler Field May 24 in honor of the president of United Aircraft & Transport Corporation, and will be used primarily in connection with the units of that company located in Hartford, the Pratt & Whitney Aircraft and Chance Vought companies. It has two steel and brick hangars—one measuring 160x125 ft. and the other 125x80 ft. They have Austin canopy doors and as the integral part of the floor of one are three scale platforms —one each for wheels and tail skid —for weighing aircraft. Bernard L. Whelan is the manager.

BATON ROUGE

Baton Rouge, La., dedicated its new 200-acre airport June 20-21. The tract has an all-way turf surface and is practically square. It is enclosed by a steel wire fence approximately 4 ft. high. The roadway which lies just outside the fence is notable as a convenient means of distributing automobiles to ample parking spaces on special occasions.

Military and commercial gatherings progress toward greater interchangeability and simplification

Standardization

A resumé of accomplishments of the recent AN Standards Conference and of the Standards Committee of the Society of Automotive Engineers

JUNE opened with the annual AN (Army-Navy) Standards Conference at the Naval Aircraft Factory in Philadelphia. During the same month the Standards Committee and the Council of the Society of Automotive Engineers met to give consideration and final approval to a group of recommendations for new and changed standards from the Aircraft and Aircraft-Engine Divisions.

The coincidence of the two meetings offers excellent opportunity for a comparison of military and industrial standardization methods and accomplishments. Conspicuous in any such comparison is the gradual passage of leadership in standardization work from the military authorities to the industry. When the S.A.E. made an active beginning of aeronautical standardization work, in 1925, it confined itself largely to echoing the results of the AN Conferences and to accepting for publication in the Society's handbook the standards that the Army and Navy had already adopted. Now, on the other hand, the industry has progressed so far toward taking control of its own standards work that in several cases, and especially on wheels and tires, agreement has been arrived at on subjects of great importance that the services had considered it premature to undertake. During the recent conference in Philadelphia there was repeated reference to the initiative taken by the S.A.E., and upon several points the AN standards and specifications were modified in order that they might be brought into agreement with the S.A.E. In discussing aluminum alloy extruded shapes, it was agreed that the services should refrain from any action until the standards already adopted by the S.A.E. had been tried out in service. At the AN Conferences the industry is welcome to participate in the discussions, but action is taken by, and upon the sole responsibility of, the Army and Navy. It assumes the final form of a command from the government services to the industry, laying down the practices to be followed in doing business with the government. The purpose of the S.A.E. work, on the other hand, following the precedent set in the Society's vast standardization activities in the automobile field, is primarily commercial and economic. The object is not so much to insure quality as to permit large-scale manufacture of identical parts, making them available at moderate price, and, by insuring interchangeability in the field, to reduce the stock of special parts that must be carried by service stations and operators. The Aircraft Division is headed by John F. Hardecker of the Naval Aircraft Factory, one of three governmental representatives among its 21 members. The others are engineers of a dozen different airplane manufacturing companies, including some that never do any government business, of accessory manufacturers, and of air transport lines. The Engine Division is under the chairmanship of Arthur Nutt of the Wright Company, with one representative each from the Army and Navy and five from other aircraft engine manufacturers.

The scope of the S.A.E. work is obviously limited by the limitations of its purpose as just stated. The Aircraft Division does not concern itself with specifications for materials or manufacturing practices (except where they affect interchangeability), nor with methods of design. The AN Conference goes into all those things. Among the items discussed at Philadelphia, but without action, were the standardization of load factors used in design and of airfoil characteristics to be used for well known sections, standard methods of static testing, and the assumptions to be made in calculating monocoque fuselage.

Tires and wheels

Probably the most important concrete development of the two conferences was the adoption by the S.A.E. of a recommended practice (somewhat less formal than a standard) for low-pressure tires and rims. It is the result of two years of discussion by a special subdivision, headed by John R. Cautley of the Bendix Brake Corporation.

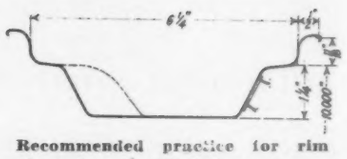
The extreme low-pressure "airwheel" was not considered for standardization, as it has been a proprietary product, but the medium low-pressure tires now coming into general use were accepted in seven sizes. Tires of 6.5, 7.5, and 8.5-in. diameter are to be recognized on the 10-in. base rim diameter. 9.5 and 11-in. tires will go on a 12-in. rim base, a 12.5-in. tire on a 14-in. rim, and a 15-in. tire on the 16-in. rim. As has been common in automobile practice since the introduction of the balloon tire, the new airplane recommended practice calls for the sizing of a tire in terms of tire widths and rim diameters as (8.5-10), instead of in terms of over-all diameter (as 32x6) which has been the common practice with high-pressure tires.

Rims for the low-pressure tires were approved in two forms, illustrated herewith, the offset type being designed to provide more clearance for the brake drum. Axle diameters for the low-pressure wheels will range from 1.5 on

the 6.5-10, and 2 in. on the 8.5-10, to 3 in. on the 15.0-16.

The recommended practice on high-pressure tires and rims was revised at this same meeting. Direct comparison of up-to-date practice on load ratings and other characteristics for the high-pressure and low-pressure types thus becomes possible. High-pressure tires are listed in three tail wheel sizes, 10x3, 14x3, and 18x3, and in eight regular sizes extending from 24x4 to 58x14, with five extra tire sizes designed for use only in oversizing for extra cushioning on a standard wheel. The sizes and inflation pressures recommended, both in the high-pressure and the low-pressure types, for use with various static loads are shown in Table I.

Roughly speaking (within about 10 per cent) the recommended static load for low-pressure tires is equal to 2 D_r d^2, where D_r is the base diameter of the rim and d the tire diameter, while the ratings for high-pressure tires are approximately 12Dd, where D is the over-all diameter of the wheel. The static loads and inflation pressures for high-pressure tires are so calculated that the tire will be flattened by 25 to 27.5 per cent of its diameter when at rest on the ground. The load factor for complete flattening of the tire at the specified inflation pressures and static loads is approximately four, while the recommended practice calls for the wheels to be proportioned for a load factor ranging from eight in the smallest sizes down to five in the largest.



Recommended practice for rim dimensions for 8.5-10 low-pressure tires. The broken line indicates the offset type, allowing more clearance for the brake drum.

Table I

Static load recommended to be carried (lb.)	High-pressure tire: Tire size	High-pressure tire: Inflation pressure	Low-pressure tire: Tire size	Low-pressure tire: Inflation pressure
400	10x3	55	.....	..
500	14x3	55	.....	..
550	18x3	55	.....	..
850	24x4	50	.....	..
1,000	28x4	50	6.50–10	20
1,250	....	..	7.50–10	20
1,600	30x5	50	8.50–10	20
2,200	32x6	55	9.50–10	20
3,000	....	..	11.00–12	23
4,000	36x8	60	12.50–14	25
6,200	44x10	65	15.00–16	25
10,000	54x12	70	.....	..
13,000	58x14	70	.....	..

Tubing, round and streamline

Another extremely important group of recommended practices adopted by the S.A.E. covered the dimensions and preferred sizes of steel and aluminum alloy tubing, both round and streamline. The subject was one on which Mr. Hardecker has personally been very active. The list of preferred numbers adopted calls for a total of 83 sizes of round aluminum alloy tubing in seventeen different gages, ranging from ¼-in. diameter by 24 gage (0.022 in.) up to 3¾-in. diameter by 11 gage (0.120 in.). The recommendations are based on a general rule limiting the outside diameter of the tube to 38 times the wall thickness. The most popular gages in aluminum alloy recommended to be carried in the largest number of diameters, are 17 (0.058 in.), 19 (0.042 in.), and 22 (0.028 in).

A total of 80 sizes of round carbon steel tube and 94 sizes of round alloy steel tube are recommended, but the gages to be used are limited to nine in number between 11 and 24, numbers 12, 15, 19, and 21 being provided for aluminum alloy but not for steel. The maximum ratio of diameter to wall thickness admitted in steel is approximately the same as in the light alloy.

Both in light alloy and in steel, tubes of larger diameter in each gage will be drawn for subsequent rolling in streamline sections. In 16-gage wall thickness, for example, the largest diameter specifically approved for use in the round tube is 2½ in., but streamline tubes are to be rolled from round ones up to 5 in. in diameter, giving a streamlined section 7.14 in. long by 2.86 in. wide. The streamline section approved as a general recommended practice has a fineness ratio of 2.5, with a radius at the tail of the section of 6 per cent of its length, and with the point of greatest diameter 45 per cent of the length of the section from the nose. Sections following the standard form will have a length 43 per cent greater than the diameter of the round tube used in rolling them. A total of 28 sizes of light alloy streamlined tube are recommended, distributed over nine gages, while in alloy steel there are 27 sizes in seven gages.

The AN Conference also discussed the standardization of tubing sizes, and the Army's representatives had come prepared with a table of proposed preferred gages and dimensions. The Army's recommendations were so different from those of the S.A.E., and from the Navy's present practice, that the matter was left in abeyance.

Standard parts

Minor changes were made in the S.A.E. standards or recommended practices for the tachometer drive attachment and for instrument case dimensions. New standards were added for brazier-head rivets and slotted shear-nuts. A number of additions and modifications for the list of standard parts, most of them pertaining to material not so far covered by the S.A.E., were proposed at the Philadelphia meeting by representatives of the services or by those of airplane manufacturers, especially the Boeing Company. It was agreed that two types of control pulleys, plain-bearing and anti-friction-bearing, should henceforth be recognized. It was agreed that standard cowl fasteners would henceforth be of steel instead of duralumin, the latter having shown some weakness. A standard for a control cable bushing was recommended but not adopted, as was a change to a smaller thread than is now regularly used on the Zerk lubricator connection. A new specification for clocks was accepted, including a standard installation drawing. Changes, although only of a very minor order, were made in standards of such fundamental importance as those for turnbuckles, eye-bolts, tie-rod terminals, and shackles.

The Aircraft-Engine Division of the S.A.E. Standards Committee revised the dimensional standards for engine starter and fuel pump mountings in certain details, and made two additions to the list of standard shaft-ends and propeller hubs. The number of taper shaft ends offered as recommended practices was increased from three to four by adding a taper of 1¼-in. base diameter and 3-in. length, to take care of the light plane engines. The addition to the table of splined shaft ends was made at the upper end, a No. 50 shaft of 3.804-in. base diameter and 5.5164-in. hub length being approved to meet the demand of geared engines of the very highest powers. The AN Conference took no action on these matters, the small taper shaft at least being of no probable military interest.

Metals, dopes, and glues

The materials sub-committee of the AN Conference gave special attention to corrosion resistant steels and to the preparation of new specifications for stainless steel sheet, tubings, and cable. The standard chemical analysis for stainless sheet ("eighteen-eight") was modified and now allows 8-10 per cent of nickel, 17-20 per cent of chromium, and 0.2-0.7 per cent manganese. Maximum limits are imposed on the content of carbon, sulphur, copper, silicon, and phosphorus. There were no other important changes in the specifications for metals, although minor changes in wording were made in several instances. A new specification was adopted on marine glue, and there was some discussion on the drying time of casein glue, one manufacturer recommending that the present specified figure of 72 hours be doubled. The matter was left in abeyance.

The Navy's representatives reported much trouble with clear nitrate dope in the tropics, and complained that the present specification was not rigorous enough to insure the highest grade of

dope. Studies will be made with a view to stiffening its requirements. A discussion on spar varnish followed somewhat similar lines, and in this case the manufacturers' representatives present were in full accord that the specification did not call for material of the highest grade. Mr. Sullivan of the Bureau of Aeronautics, presiding at the meeting [and author of the article on the corrosion of duralumin rivets appearing in AVIATION for June] threatened the industry with the possibility of the Navy's manufacturing its own spar varnish if means could not be found of insuring that a satisfactory product would be delivered by the commercial manufacturers on specification.

It has been the usual rule, when the Army and Navy were at variance on a material specification, that the Navy's stipulations were the more severe, since the conditions of service of sea-going aircraft are in general much more difficult than those for the Army machines. Plywood specifications have been a notable example in the past, the material to meet Navy specifications at times costing two or three times as much as that which suited the Army's needs. The discussion on wool felt at the recent conference presented a departure from the usual rule, for the Army Air Corps was insistent upon 100 per cent wool content, while the Navy reported that a wool content of 60 per cent had proven entirely suitable for its purposes. The cost of material made to the Army's limits sometimes runs five times as high as that prepared in accordance with the Navy's proposal. Further tests are to be made in the endeavor to secure agreement.

Engines, shielding and radio

The power plant sub-committee at the AN meeting touched on material specifications in its discussion of the standardization of grades of fuel and methods of testing, a point upon which some of the large refiners are anxious to secure action. Nothing definite was done. Also held over for further discussion was a proposal to standardize the location of thermocouples in engine cylinders and the means of installing them.

The electrical equipment and radio sub-committees paid special attention to magnetic and electrical shielding and to conduit installations. The means of testing the efficiency of engine shielding and so preparing specifications were discussed at length, but no action was taken except to agree on further investigation along definite lines. Conduit fittings were agreed to be of immediate importance, and the representatives of the Navy undertook to continue energetically with the development of a standard series of fittings, preliminary samples of the Navy's general type being considered more promising for ultimate general adoption than any of the others that were examined by the conference.

The 250-ton Northrop hydraulic brake

A 250-ton metal forming brake

Hydraulic unit designed by Northrop engineers

A SPECIAL hydraulic brake of 250-ton capacity has been designed by engineers of the Northrop Aircraft Corporation, and installed in their new factory at Burbank, Cal. It was necessary to design the machine locally, for a standard hydraulic press to fill the very special requirements was found to be almost prohibitive from the standpoint of bulk and first cost.

The machine has a capacity to handle sheet metal up to 15 ft. long and ⅛ in. thick. It is set on a heavy concrete base to insure absolute alignment of the lower beam. The latter is operated by six hydraulic cylinders equally spaced along its length supported by a heavy built up overhead plate girder. Any distortion of the girder under load does not affect the accuracy of the work as the pressure is automatically equalized in all six cylinders insuring uniformity of pressure between the working faces. By means of simple adjustments, tapered sections may be handled or the brace arranged to apply varying pressures along its length. Its cylinders are operated through suitable valves from a Hele-Shaw hydraulic pump of 2,500 lb. per sq.in. capacity, driven by a 35-hp. General Electric motor.

Flying Equipment

CONSOLIDATED TRAINER

TO AN unusual degree the new model 21-A Trainer, of the Consolidated Aircraft Company of Buffalo, N. Y., has been designed around the requirements for minimum maintenance and greatest ease of inspection and servicing. The outstanding feature in this connection is in the extraordinarily complete application of ball bearings. The flight controls are fully ball-bearing at every connection, including all elevator, rudder and aileron hinges, guide pulleys, and all clevis mast attachment points. The bearings are made of stainless steel, are water and dust-proof, and require but one lubrication for the life of the airplane. The only wearing points at which ball bearings have not been used are at the main fittings where the undercarriage is attached to the fuselage. At these four points, however, generous bronze bushed bearings are provided, fitted with Alemite grease gun connections. The connecting bolts are of hardened alloy steel, and the bushings are readily replaceable for wear without disturbing the fuselage structure. All bolts used at wing hinges, inter-plane strut connections, etc. are tapered and hardened to take up any wear from vibration, and in calculating the strength of such bolts the bearing stresses have been assumed to be one-half the yield for the materials used. Particular attention has been paid to accessibility of important parts throughout the airplane. Numerous zippers have been provided, and the entire metal cowling at the rear, and on the under part of the fuselage forward of the rear cockpit is readily removable.

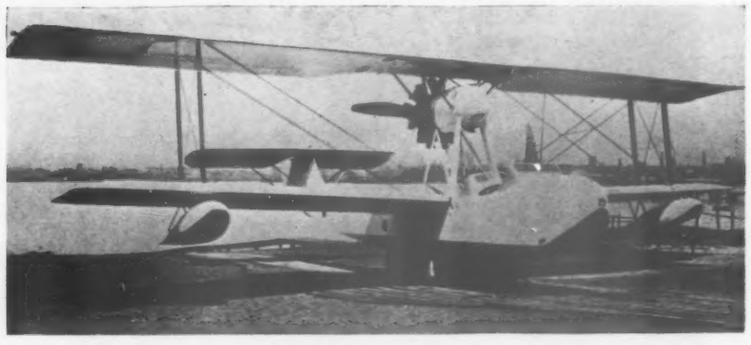
The Consolidated 21-A trainer

The general arrangement of the machine is conventional. It is a two-place open cockpit staggered biplane having straight wings of equal chord and equal spans with elliptical wing tips. For training purposes, it is to be powered with the Wright J-6 five-cylinder, Kinner C-5 five-cylinder, or the Continental seven-cylinder engine, all of which are rated at 175 hp. For advanced training, or where exceptional performance is required, either the Pratt & Whitney Wasp Jr., or the Wright J-6 of 300 hp. may be substituted. Fuel is carried in an aluminum tank enclosed in the center section, having a capacity of 43 gal. For the higher powered engine installations mentioned above, an additional tank is provided in the fuselage under the cowling.

The fuselage is built of chrome molybdenum steel tubing, and is designed with a detachable engine mount section. Wing spars are of laminated solid spruce with chrome molybdenum fittings, ribs are of heat-treated dural, and the entire assembly is fabric covered. Ailerons consist of heat-treated dural ribs, assembled on a tubular dural spar, fabric covered. The attachment of the wing fittings to spars is through the medium of Bakelite bushings to reduce bearing loads below the elastic limit of the spruce.

The details of the undercarriage are very interesting, and are covered in detail in the Design Novelties section of this issue of AVIATION. In general it is of the divided axle type, of tubular chrome molybdenum steel construction, fitted with oleo shock absorbers, semi-balloon tires, and brakes. The tread is 84 in. The tail wheel will be described in a later issue. Tail wheel or skid are interchangeable. Both are steerable and releaseable at 90 deg. for a full 360 deg. swivel.

Elevator and ailerons are operated by push and pull tubes. A special operating mechanism is used for the ailerons which eliminates all exposed control parts and masts. The stabilizer is adjustable from both cockpits through beveled geared ball-bearing control with a non-jamming stop. Indicators are provided on each control in each cockpit. The fin is adjustable from the ground only. Engine controls are direct operating push and pull rods, there being no torque tubes used. Indirectly lighted instruments are mounted on boards which are completely covered with sponge rubber crash pads, 1½ in. thick.



The Viking flying boat

The exceptionally clean lines of this airplane are due to the amount of thought expended on details which are commonly overlooked. For example, the usual hand fire extinguisher is installed in a streamlined container partially on the outside of the fuselage and partially set into it so located that it can be reached either from cockpits or the ground. The starter crank socket which ordinarily projects through the engine cowling is provided with a special telescopic extension rod which is pulled out for cranking purposes and

completely enclosed within the cowl when in flight. The starting crank handle is stowed in the engine compartment. Metal housings and flexible boots completely enclose all the exposed fittings of the undercarriage. Flush type hinged covers provide access to the enclosed oleo gear.

The general specifications of the plane, as furnished by the manufacturer, follow:

Span	31 ft. 6 in.
Length overall	25 ft. 8 in.
Maximum height (flying position)	7 ft. 0 in.
Wing area (including ailerons)	266 sq.ft.
Weight empty	1680 lb.
Useful load	700 lb.
Gross weight	2380 lb.
Wing loading	8.96 lb. per sq.ft.
Power loading	13.6 lb. per hp.

VIKING FLYING BOAT

BASED primarily on a design originated in France by the Schreck F.B.A. Company, the Model V-2 Viking flying boat, manufactured by the Viking Flying Boat Company of New Haven, Conn., uses American construction methods, materials and engines, and is manufactured under the Department of Commerce approved type certificate No. 361.

The machine is a four-place, hull type, open cockpit biplane, powered with a seven-cylinder Wright 240-hp. engine, mounted as a pusher in a nacelle supported between the wings. The cellule is of conventional single bay type, with wings of all wood and fabric construction, using a modified Eiffel 359 airfoil. They are not tapered either in plan or in section, and the tips are practically square with some rounding at the corners only. Both upper and lower wings are rigged with slight sweepback (averaging only 2 deg. from the normal), and although the upper panels have no dihedral, the lower are rigged with a dihedral of 2 deg. and 20 min. A wire is used at the trailing edge which gives a slightly scalloped effect, typical of foreign design. Ailerons are of two spar, wood construction with plywood covering between spars, and are operated by a push rod and bell crank through the wing and by a cable which runs down the engine mount strut to the cockpit.

Tail surfaces are of wood, fabric covered, with the exception of the fin which is entirely covered with plywood. Rudder and elevators are operated by push rods. The fin is wire braced to the stabilizer and the latter is braced to the hull by streamlined steel tube struts.

The principal deviation from usual American flying boat design is in the hull, which is constructed entirely of wood, has a single step, and is flat-bottomed. Aft of the step the lines of the hull are sloped upward in a graceful curve to carry the tail surfaces well clear of the water. The general effect is a smooth continuity of line from bow to rudder which is typical of many French flying boat designs. In defence of the flat bottom, the manufacturers claim that quicker take-offs and smoother landings are posible on a bottom of this type for comparatively small boats of low horsepower than for the more usual vee-bottomed boat. From a handling and servicing point of view the flat bottom permits the boat to be slid about on a ramp or run-way under its own power like a sled, and the simplicity of line permits even an amateur woodworker to make emergency repairs. It is claimed also that in case a landing on the ground becomes necessary, the flat bottom is essentially safer than a vee. The hull is provided with two towing rings on either side, one on the nose, and a combined handling grip and skid under the tail. The entire machine may be lifted in a sling attached to four lifting lugs on the upper center section.

A 48-gal. gasoline tank is located behind the rear cockpit in the hull, and a 12-gal. tank under the rear seat. The engine is supplied by a power-driven pump, supplemented by a hand wobble pump for emergency use. The oil supply tank is located in the front part of the engine nacelle which makes any other oil-cooling system unnecesary.

The manufacturer's specifications are:

Maximum span	42 ft. 4 in.
Length overall	29 ft. 4 in.
Height overall	10 ft. 4 in.
Total wing area	401.5 sq.ft.
Weight empty	2300 lb.
Useful load	1150 lb.
Gross weight	3450 lb.
Wing loading	8.6 lb. per sq.ft.
Power loading	14.4 lb. per hp.

The Paramount Sportster, float seaplane

PARAMOUNT FLOAT SEAPLANE

FEW airplanes today, outside of those designated specifically for the naval services, are designed primarily as float seaplanes. The average machine of this character is primarily a land plane which has been adapted to over-water flying by the removal of the usual wheels and the substitution of float gear. The Paramount Aircraft Corporation of Saginaw, Mich., has placed on the market, however, a twin-float seaplane intended for sport use. They have departed from their usual cabin biplane designs, and have produced in this case a low-wing open cockpit monoplane.

The machine seats two persons side by side. The power plant is a 110-hp. Warner Scarab arranged as a tractor in a fuselage of conventional arrangement. Engine cowling of the Townend type permits good streamlining. Wings are of Clark Y section made up in two panels, each attached to a short center section stub which is strut braced from the upper longeron and carries the float struts at the outer end. Wing panels one wire braced from the upper longeron and from the strut fittings at the decks of the floats. Materials and construction are conventional throughout. The general specifications of the manufacturer follow:

Length overall	23 ft. 9 in.
Height overall	10 ft. 2 in.
Maximum span	30 ft.
Wing area	130 sq.ft.
Gross weight	1,600 lb.
Weight empty	1,060 lb.
Useful load	540 lb.
Wing loading	12.3 lb. per sq.ft.
Power loading	14.5 lb. per hp.

APPROVED TYPE CERTIFICATES

DURING the period June 13 to July 10 the Aeronautics Branch of the Department of Commerce issued the following Group I approved type certificates: 427, Spartan C2-60 (Jacobs L3 60 hp.); 428, Fleet, Models 8 and 9 (Kinner B5 125 hp.); 429, Curtiss-Wright Travel Air, 16W (Warner Scarab 110 hp.); 430, Franklin, Model 90 (Lambert 90 hp.); 431, Ford, 13A, (two Wright R975s 300 hp. and one Wright Cyclone 575 hp.); 433, Pitcairn Autogiro, PAA-1 (Kinner B5 125 hp.); 434, Rearwin Junior, 3000 (Szekely 45 hp.).

Aircraft at Work

A Keystone duster of the Delta Air Corporation working on a field of cotton with ground dusting equipment

Dusting gains favor; oil spray successful

DELTA Air Corporation, one of the world's oldest aerial dusting organizations, with headquarters at Monroe, La., has recently extended its activities in California and the Southwest and reports a rapidly increasing application of aerial dusting to new uses. Recent contracts successfully completed included seeding and fertilization from the air.

A comparatively new development has been the application of oil from the air for mosquito control in swampy areas. The application of insecticides and fungicides by plane is now regularly being done for the protection of cotton, grapes, sugar cane, melons, tomatoes, peas, peach, pecan, and apricot orchards. Other fields are steadily being developed.

As agriculturists learn of the advantages and economies of aerial dusting this method is supplanting ground dusting of crops of almost all types on large ranches. The airplane is capable of treating approximately 100 acres of orchard with heavy applications, or 1,500 to 2,000 acres of cotton with light applications, in a single day.

Major Livingston Irving, of Oakland, Cal., has done considerable oil spraying of mosquito marshes near San Lorenzo, Cal., for the State Agricultural Department, as a side-line to his regular crop-dusting activities. This method of attack on mosquitoes is quicker and cheaper than with hand equipment. Major Irving also has developed a profitable business of rice sowing. Only slight modifications in his equipment is necessary for these various operations.

Aerial photographs for golf score cards

THE Curtiss-Wright Flying Service photographic division is now making photographic golf score cards as a result of the favorable reception of the idea when first introduced in the National Open Championships of 1929 at Wing Foot Golf Club, Rye, N. Y. At that time detailed records of the direction of each shot and the lie of the ball were made on photographic reproductions of the course as the leading players went their rounds. The most interesting record, of course, was that of the final play between Jones and Espinoza.

The photographs used for the score cards were made in about a week of flying back and forth over the course by expert aerial camera men. First a complete air picture of the course was secured. Separate shots of each hole—including tee, fairway and green—were made along lines developed in consultation with the club's officials. They were taken at an altitude of about 5,000 ft.

This style of score card adds considerable interest to the scoring. It provides a permanent and accurate record of the plays in important matches. It also affords the stranger to the course an opportunity for better judgment of his blind shots. The make-up of a page of the score card is shown below.

Aerial survey for Venezuela oil sites

THROUGH the work of L. E. Shealy with their Sikorsky S-38 amphibion, the Creole Petroleum Corporation

The eighth hole at Wing Foot. Lines may be drawn to represent the direction of each play or marks may be used to indicate each lie

completed in April an extensive survey of the interior of Venezuela for oil sites which, with conventional means of transportation, probably would have required about ten years. For about a year the plane was never under a hangar's protecting roof, and with but a few exceptions all landings were made on waterways of the interior and along the coast, or on rough, improvised landing fields. The machine was used also for transporting officials and payrolls.

The only accident during this period of rugged service was caused by a hurricane which ripped the plane away from its moorings and capsized it, damaging the wing to the extent that a new one was ordered from Bridgeport. The expedition carried three engines, one a spare. Every 150 hours, an engine would be shipped back to Hartford for Pratt & Whitney overhaul and a substitute installed. Spares and repair facilities were not available at the base.

The plane carried a Folmer Graflex K-5 and Fairchild F-4 aerial cameras for the survey work. It was the practice to cruise back and forth over a predetermined area and photograph it. Examination of the prints would reveal the geographical tell-tales indicating oil possibilities which merited ground inspection. Much oil was found. Shealy had to make his own maps. He would jot down notes and symbols on a piece of blank paper on each flight and gradually developed a chart on which he could rely.

L. E. Shealy (left) and the Creole Company's Sikorsky S-38

Technical Abstracts

WASSERKUPPE SOARING CONTEST

ELEVENTH ROHN SOARING-FLIGHT CONTEST, 1930, *by Walter Georgii; N.A.C.A. Technical Memorandum No. 623.*

TO AN out and out soaring enthusiast with no jealousy in his soul, to a scientist whose outlook recognizes no international boundries, this account of the eleventh Rohn Soaring contest is an inspiring document. To a nationalist cherishing hopes for his countrymen to excel in all activities it is profoundly discouraging. For any other nation even to aspire to approach Germany in the field of motorless flight for organized and sustained effort, scientific study and utilization, and consistent record breaking achievement, seems as hopeless as for the University of Prague to cherish a desire to smear a football team from Notre Dame.

Two difficulties beset the meet in 1930, the first was the general financial depression which made it difficult for the individual clubs to raise funds for building their craft and participating, and for those managing the meet to collect sufficient money for the expenses incurred. The second was the weather. Only ten of the sixteen contest days permitted any flying at all and on those rain and clouds were prevailing. In the face of these conditions it is nothing less than remarkable that previous record performances were generally exceeded. Even more astounding was the improvement in the number of those who made noteworthy flights.

Of chief spectacular interest was of course the cross country flight of 101 miles by Kronfeld which beat his previous best attempt by about 9 miles. More fundamentally important in this event were six flights by five different pilots of over 15 miles and the general revival of interest of using currents from mountains and forests as well as from cloud formations for attaining long distances, the latter type of currents occurring rarely during the eleventh meet.

Dr. Georgii brings out the importance demonstrated in the 1930 distance flights of completely planning such flights in advance. So far only Kronfeld and Nehring seem to have done this. One must carefully study the terrain at each point on the proposed route under the expected air conditions, have a course completely plotted on the map, and have a very definite plan of campaign thoroughly memorized for the beginning of the flight. "Kronfeldt is no pathologically gifted soarer, but an unusually sensible pilot who first thought out his flight with understanding before executing it with skill."

In the altitude flights the previous year's record of 7,087 ft. was unequaled, although Bedau reached 5,380 ft. This flyer on the last day of the meet passed from the up currents on the Wasserkuppe into the lower part of a cumulus cloud whose up-wind gradually carried him to 5,250 ft. After the first climb the up-wind slackened until suddenly in the 226th minute an exceptionally strong up-wind lifted the glider almost 3,000 ft. in three minutes. This was followed by a fall in which the glider acquired a falling speed of about 82 ft. a second. This range of speeds clearly demonstrated the extraordinary velocities of vertical currents prevalent in cumulus clouds even of the most innocent appearing variety.

In 1929 for the first time eleven soaring planes were in flight over the west slope of the Wasserkuppe. In 1930 the number was increased to fourteen or nearly half of all the gliders participating in the contest. Of the seventeen gliders taking the air on that day, only one met with an accident. One of the features which seems to have contributed largely to the success of the meet was that of holding district meetings at various other localities previous to the Rohn contest; prizes being offered for soaring flights to be made between May 15 and Aug. 17 at the home fields of the primary gliding clubs. This seemed to result in arousing and keeping alive interest in such flying during that period. Also of great value in the consistent development has been the primary class meeting concurrent with the soaring at Wasserkuppe.

ALLOY STEEL WING BEAMS

DEVELOPMENT OF STEEL WING BEAMS FOR AIRCRAFT, *by H. C. Knerr and H. A. Backus;* Iron Age, *Feb. 26, 1931.*

CERTAINLY the most complete article so far published on steel wing beams is this by Mr. Knerr and Mr. Backus. Alloy steels are available to the aeronautical industry with tensile strengths as high as 200,000 lb. per sq.in. Such material, if its full strength can be realized in its final fabricated form, offers a strength-weight ratio superior to that of wood and duralumin. Within the last two years furnace developments have made it practical to heat treat entire wing beam assemblies in their final form. Previously difficulties from warping had been experienced using the horizontal furnaces. The type of furnace now used is a vertical one with quenching tank immediately below. The actual gravity forces exerted by the parts of the spar tend more toward straightening than toward setting up

any warping. Not only has the heat treatment resulted in realizing the high strengths in the main structural parts of spars, but the welded joints themselves have returned practically to the strength of tubing.

The article discusses completely various general features and details of the spars developed for the Curtiss Condor and Kingbird, the tri-engined Stinson, the Fairchild photographic plane, the Bellanca Air Bus, and others. Certainly if the progress of the last two years in this field of design is continued, there is no doubt but that the majority of large airplanes will take advantage of it.

RAF-6 AND CLARK Y PROPELLER SECTIONS

COMPARISON OF FULL-SCALE PROPELLERS, HAVING RAF-6 AND CLARK Y AIRFOIL SECTIONS, *by Hugh B. Freeman; N.A.C.A. Report No. 378.*

EARLY aerodynamic research in connection with propeller design was carried out largely in England. One of the most important contributions was the development of a group of airfoils based on the RAF-6 section with varying camber to chord ratios. This family of sections and the blade plan forms developed for it have even since been the basis of the great majority of wooden propeller designs.

When aluminum alloy propellers came into vogue this same family of sections, though of course combined with new plan forms, was used to some extent. For the past three or four years, however, a new family of sections based on modifications of the Clark Y has been developed by the Army and Navy design sections here in the United States. Little has been known to date as to the comparative efficiencies of these two groups of sections. Report No. 378 is, therefore, very timely and definitely and immediately useful.

Six full scale propellers were completely tested in the propeller research tunnel of the National Advisory Committee for Aeronautics. Three had RAF-6 and three Clark Y airfoil sections. One each of both sections had thickness over chord ratios of 0.06, 0.08, and 0.10. Tests were run at five pitch settings for each propeller.

The results are quite interesting. On low pitched propellers the Clark Y sections gave higher peak efficiency than the RAF-6 sections. On high pitch propellers the RAF-6 sections gave about the same peak efficiencies and greater efficiencies for the conditions of climb and take-off. Lastly, the maximum efficiency of low pitch propellers with RAF-6 sections decreased slightly with increased blade thickness, but with Clark Y sections, the efficiency actually increased although the increase was very slight.

17ST AND STEEL TUBULAR MEMBERS

COMPARISON OF WEIGHTS OF 17ST AND STEEL TUBULAR STRUCTURAL MEMBERS USED IN AIRCRAFT CONSTRUCTION, *by E. C. Hartmann; May, 1931; N.A.C.A. Technical Note No. 378.*

THE field of aeronautics seems particularly productive of topics for technical debate—the best number of lifting surfaces—the safest number of engines—the position of a monoplane wing in relation to the fuselage. One of the more modern of these moot questions has resulted from the parallel developments of aluminum alloys and high tensile steel for structural purposes.

The paper under discussion was written by E. C. Hartmann of the Aluminum Research Laboratories to put on a scientific and quantitative basis some of the considerations in this rivalry. Like the vast majority of other technical questions, there is no one particular and final answer because in addition to the purely technical question of strength-weight ratio, there are also the problems of cost characteristics of terminals, rigidity of assembled members, resistance to corrosion, and possibly even other factors whose weight must vary in the considerations which would lead to the adoption of one or the other for any one particular purpose.

This technical note limits itself to a discussion of the strength-weight ratios of tubular structural members of the two materials. It considers such members in tension, loaded as beams, in compression, under combined bending and compression, and after local buckling. The discussion assumes the shape of a mathematical analysis and general considerations of a previous technical note (No. 307), which reported a number of practical tests of tubing. The results might be summed up as quite favorable to the dural (with 17ST) members. While it is possible to secure steel tubing at the present time of extremely high ultimate tensile strength, it must be remembered that the real utility of a structural material is very often more a question of yield strength and modulus of elasticity. The conclusions are as follows:

1. A steel tubular structural member designed for any ratio of d/t (outside diameter to wall thickness) can be equalled in strength by a 17ST tubular member having the same d/t ratio at a substantial saving in weight as indicated below.

(a) If the yield strength of the steel is equal to that of 17ST, the 17ST tube will be from 38 to 64 per cent lighter.

(b) If the yield strength of the steel is about equal to 97 per cent of the minimum tensile strength for alloy steels stated in the U. S. Army Air Service Specifications No. 10231-B, say 92,000 lb. per sq.in., the 17ST tube will be from 10 to 40 per cent lighter.

(c) If the yield strength of the steel is raised to about 115,000 lb. per sq.in., the 17ST tube begins to lose its weight-saving advantage for tension members and short columns but retains some advantage for beams and long columns.

(d) Regardless of the other properties of the steel, if the modulus of elasticity remains about 30,000,000 lb. per sq.in. the 17ST tube will always be 39 per cent lighter than the steel tube for long columns and for beams designed for a given deflection.

2. Under the conditions stated for the first conclusion the 17ST tube will have a larger outside diameter than the steel tube in the four cases as indicated below:

(a) If the yield strength of the steel is equal to that of 17ST the diameter of the 17ST tube will be from 0 to 31 per cent larger than that of the steel tube.

(b) If the yield strength of steel is 92,000 lb., per sq.in. the diameter of the 17ST tube will be from 31 to 58 per cent larger.

(c) If the yield strength of steel is 115,000 lb. per sq.in. the diameter of the 17ST tube will be from 31 to 72 per cent larger.

(d) For long columns and for beams designed for a given deflection the diameter of the 17ST tube will be 31 per cent larger.

3. If it is specified that the outside diameter of the 17ST tube cannot be larger than that of the steel tube, 17ST loses much of its weight-saving advantage for columns and beams. In long columns and in beams designed for a given deflection, steel tubes will be lighter regardless of the yield strength of the steel. In short columns and in beams designed for strength the 17ST tube will be considerably lighter if the steel has a yield strength about equal to that of 17ST but will lose this advantage rapidly as the yield strength is raised. If the steel has a yield strength of more than 115,000 lb. per sq.in., the steel tube will be lighter than the 17ST tube for all loading conditions.

4. If the d/t ratio for a 17ST tube must be kept smaller than that for a steel tube because of the likelihood of local compression failure, 17ST loses some of its weight-saving advantage in short columns and in beams designed for strength but not as much as indicated above for the condition of equal outside diameters.

5. For most tubular structural members 17ST should be able to compete easily on a weight basis with any steel having a yield strength less than 90,000 lb. per sq.in. In some cases it should be able to compete with steels having yield strengths as high as 115,000 lb. per sq.in.

Airport Management

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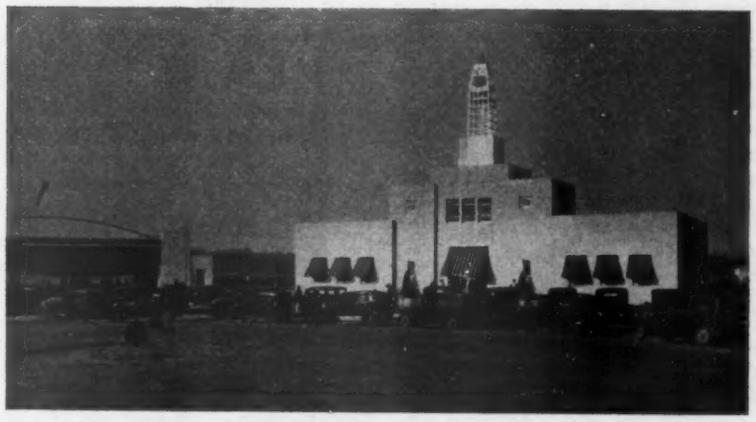
Metering fuel in the field

IT sometimes happens that a number of planes must be serviced at an airport with a fuel not regularly kept on hand there, or that for some reason it is inconvenient to taxi the machines to fueling pits. It then becomes necessary to take care of them on the field or along a parking line. If the quantity of fuel needed is very large, and if all the machines belong to a single owner, as in the case of the recent Army maneuvers, gasoline can be supplied from tank trucks with the remaining contents gaged after all the machines have been taken care of.

When variable and small amounts of fuel have to be supplied to a number of planes and each one charged individually, however, that process is less satisfactory, and a tank truck with accurate metering facilities is then of great assistance. Certain oil companies have solved this problem by mounting on trucks or trailers a standard pump essentially like those used in filling stations, except that it is of somewhat lighter construction. It is supported on a temporary tailboard and piped directly to the tank.

The pump may be either hand or power driven, usually the former, and so set up as to be easily demountable. It constitutes essentially a portable filling station of some 1,500-gal. capacity, and is a very useful adjunct to the fuel supply system of an airport in time of special stress, as during air meets and visits of air tours.

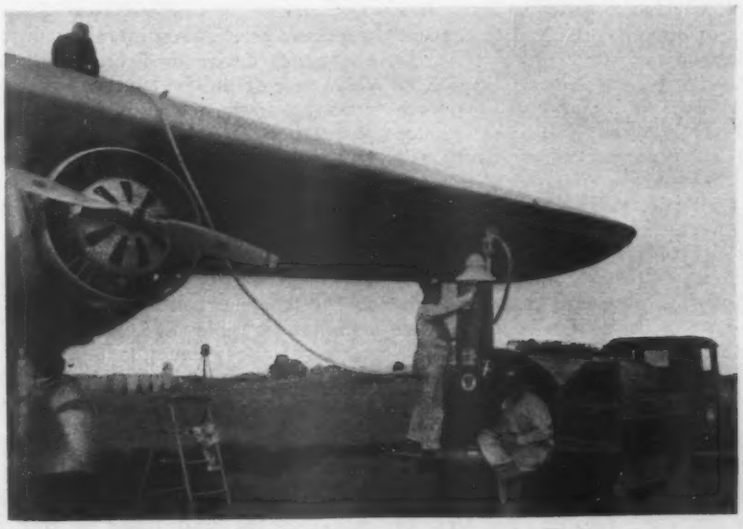


Administration building and hangar at Baton Rouge (La.) Municipal Airport. Note the steel tower supporting the airport and code beacons and the architectural treatment of the administration building.

Baton Rouge's municipal airport

TWO interesting features characterize the 200-acre municipal airport which Baton Rouge, La., dedicated June 20-21. One of these is a 100-ft. wide roadway beside the 4-ft. fence which encloses the entire area. This road offers excellent driving and parking facilities. Another is the decorative steel tower housing the airport beacon and the code beacon. As shown in the illustration, the code beacon is on the top platform and below it is the revolving beacon on another platform.

The field itself is practically square, measuring approximately 3,200x4,000 ft. Excellent natural drainage qualities are supplemented by a subsoil system in one small portion. An attractively designed administration building of brick and steel has the usual accommodations and a roof garden. The hangar is of similar materials and measures 140x120 ft. The port is completely lighted. It is ideally located, being but five miles from the post office on two paved highways. The construction was financed by a small parish-wide tax spread over a period of five years.



A gasoline truck and pump for dispensing fuel in the field

Specializing in engine service

THE new Rentschler Field at East Hartford, Conn., is an airport specializing in engine service and overhaul. Complete equipment, including special tools, for handling Pratt & Whitney products is available in the large shop which extends along one side of the commercial hangar. This is operated by United Airports, a United Aircraft & Transport subsidiary, which owns the field. The shop is able to handle everything in the overhaul line that the factory can. Formerly the overhauling was done at the factory but improve-

ment in this service is obtained through the concentration.

There are two hangars on the field. The United hangar, operated for general patronage, has a clear floor space 125 ft. wide and 160 ft. deep. The sides are parallel with the edge of the field and the shop lean-to, measuring 40x100 ft. adjoins the building on the far side. The office lean-to, on the field side, is likewise of one story but measures 20x160 ft. It is finished in Colonial style. Leading off the large reception room is the office of the port manager, B. L. Whelan.

The other hangar, which is leased to the Pratt & Whitney Aircraft Company for experimental purposes, has a floor space of 125x80 ft. This will be enlarged eventually to the size of the other building. It has a two story office lean-to and shop space.

This hangar has a new feature in scales for the weighing of aircraft. The platforms or plates of the scales are fitted flush with the floor and form a letter "T." The top bar of the "T" is the plate for the wheels and the long arm is for the tail skid. Any size machine may be accommodated. Wells beside the plates permit ready adjustment of the apparatus and reading of the figures.

The buildings are of steel and brick construction. They have both sprinkler and deluge type systems and supplementary fire apparatus. The field is allway with turf surface and is drained by 40,000 ft. of metal culvert.

As a contact medium between the United companies and commercial aviation, the field is available to any pilot. A number of Colonial transports have been housed there over night, for instance when the machines have been grounded on their regular runs. Any make of engine may be overhauled in the shop, which has a capacity of ten of the Pratt & Whitney types.

Descriptive folder helps the port and the visitor

COMPLETE information about the facilities at airports for the benefit of visitors, whether they come by land or by air, serves a three-fold purpose. The pilot is told the names of the companies operating at the field, the service they render and what accommodations are available. The spectator is given a bird's-eye view of the plant, its purpose and functions and is thus initiated into an intelligent understanding of operations which otherwise might remain somewhat mysterious to him.

There are two interesting examples of airport folders. One is prepared by the Aviation Bureau of the Boston Chamber of Commerce and is entitled Information for Visitors and Pilots. A map showing the location of the Municipal Airport in relation to Greater Boston is

Industrial Club of St. Louis Chamber of Commerce and the Descriptive folders of the Boston

supplemented by photographs of various buildings and points of interest. The text describes the buildings, the radio beacon, the various companies operating on the field, and their service.

Another excellent example is a pamphlet entitled Air Transport Facilities in the St. Louis District, which is published by the Industrial Club of St. Louis. As the name implies this covers more than one port but happens to give most space to the Lambert-St. Louis Municipal Field. Its local map is supplemented by a map of the United States showing St. Louis' relative position in regard to important cities throughout the country.

Traffic signals tentatively adopted

TO MEET problems of traffic control, which are growing acute at a number of our airports, and to prepare for adequate control at other ports as traffic increases, the Airport Section of the Aeronautical Chamber of Commerce has taken preliminary steps to introduce practices and mechanical aids which will be both adequately effective and standard for all ports. This action was initiated at the Third Annual Airport Conference of the section at Tulsa in March, and is being carried on in cooperation with the study of the problem on the part of the airport section of the Department of Commerce.

The Chamber's committee studying this phase of airport management consists of two divisions, one made up of East Coast managers and the other of West Coast managers, for the benefit of geographical representation. The former includes George W. Orr of Roosevelt Field, chairman; Richard W. Aldworth, Newark Municipal Airport; W. Sanger Green, Central Airport, Camden, N. J.; and Herbert H. Mills, Brainard Field, Hartford. The latter includes Col. R. B. Barnitz, chairman, Director of Airports of the City of Los Angeles, Fred Denslow, United Airport, Burbank, and Major C. C. Mosley, Grand Central Air Terminal, Glendale, Cal.

The East Coast division held its first meeting in New York City June 17 and, limiting its deliberations to control of planes in the air, evolved a traffic control system which the entire committee will study for probable recommendation to the whole Airport Section. The mechanical system proposed is based on experience with a two-light gun used for starting planes at the busy Washington Airport, serving the District of Columbia, and a three-light gun system developed at Newark.

The Washington gun was described in this section of the May issue of AVIATION. The Newark system goes further than the Washington device. It uses three lights—red, green and another, probably amber—each a searchlight. The latter two are equipped with 12-in. barrels to limit the spread of the beam. The red light is fixed and shines vertically upward permanently, visible in all directions. The green light is on a movable base so that it can be directed at the plane in the air and the amber light is movable so that it can be directed to that area of the airport where it is desired the plane should be landed.

When a plane arrives at the airport the pilot circles in the usual manner, but continues beyond the required 180-deg. arc until he sees the green light. This is pointed at him by the operator and is powerful enough to attract his attention at once. He then glides in for a landing, noticing as he does so where the yellow spot from the amber light is located. This is directed also by the operator. It shines through the floodlight glow, making a definite oval of light about 14 ft. in diameter on the airport surface.

The amber light is in reality just an emergency device to direct a pilot to a clear part of the field in the event of a crack-up or the presence of some other obstruction on the landing area. The red light is kept burning permanently in order to enable the operator to select planes to land in turn when more than one arrive over an airport at about the same time. All can see the red light glow and will remain in the air until this is supplemented by the green. The operator is able to sight along the barrel of the green gun and pick out just the plane desired. Having "covered" this machine he lights the light and follows the plane until it is on the ground. Then the green and amber lights are extinguished, leaving just the red light burning, until the operator picks out the next plane to land and "shoots" it with the green light.

Servicing Short Cuts

STATIC ELECTRICITY SAFETY MEASURE

IN order to insure that an airplane structure is at zero electrical potential before an attempt is made to fill its gasoline tanks, a simple grounding device has been developed in the shops of the Ludington Lines at Washington. To the framework of the steel stepladder regularly used to give access to the tanks a short length of flexible electrical conductor cable has been welded which carries on its free end a large clip similar to those used in making external connections to storage batteries while charging. As the servicing man climbs the ladder with the gasoline hose, he fastens the clip to the metal cowling of one of the wing engines and proceeds with the refueling without danger of fire starting with a discharge of static electricity to the hose nozzle.

A simple grounding device prevents a discharge of static electricity during fueling operations

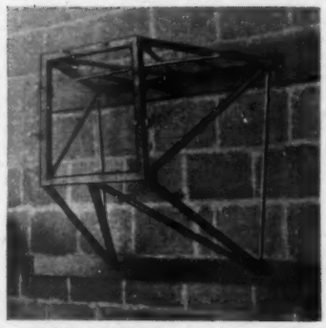
PORTABLE WORK BENCHES

CONSIDERABLE time is saved to mechanics in the shop of Eastern Air Transport, Inc., at Atlanta, Ga., through the use of portable work benches, which make it unnecessary for a man to carry a part on which he is working to some distant point. Benches are solidly constructed of hard wood and are mounted on four heavy castering wheels which permit pushing from place to place with a minimum effort. Each is equipped with a large vise and a drawer containing the small tools. Each department is assigned one or more benches and the equipment they contain varies, depending upon the work which the particular department performs. In order to avoid confusion the name of each department is stencilled plainly on each bench.

SERVICING LAYOUT FOR PROPELLERS

THE equipment and layout of the Ludington Lines at their Washington, D. C., shop for servicing the propellers of the tri-engined Stinsons, is shown in the accompanying photograph. It is to be noted that the importance of good lighting for making visual inspection of propellers has not been overlooked in selecting a location for the shop. The arrangement of racks, etching tanks, protractor, and balancing stand makes for convenient handling of the several operations. Note also the portable electric buffer which can be moved easily and quickly to any desired location.

Propellers are inspected on the plane at the end of each run, and at the regular weekly airplane check-up. With the removal of engines from airplanes at the end of every 300 hours of operation, the propellers are removed and sent to the propeller shop for a thorough checking. They are examined carefully for mechanical damage, inspected for signs of fatigue cracks, and checked for pitch, balance, and tracking before being returned to service.



Wall mounting for radial engines

STANDS FOR RADIAL ENGINES

FOR purposes of storage, or for making minor adjustments, the Atlanta, Ga., shop of Eastern Air Transport, Inc., is using an ingenious engine supporting device. A welded steel framework, consisting of tubing and small angles, is made up to resemble the nose of a fuselage. This framework is attached to wooden mounting strips supported firmly on a solid wall, and carries on its outer face a row of studs corresponding to the mounting bolt holes on the engine. When mounted on the stands, engines are firmly in a position where adjustment work may be performed conveniently.

The Ludington propeller shop at Washington

Design Novelties

An example of rugged construction

TO MANY persons, one of the chief characteristics of airplane structure is apparent frailty. That this idea has

Tail control assembly of the Northrop Alpha

some rational basis must be admitted for the "stick and wire" methods belong to the not far distant past, but with the improved materials and methods used today, such a criticism by even the most casual observer is becoming unjustified. A good example of the current tendency toward rugged construction is shown in the accompanying photograph of the tail of the Northrop Alpha in which the tail cap has been removed to show the mounting and arrangement of the elevator and rudder control. The total absence of wood, wire, or fabric, is striking, and the assembly would seem sound to an engineer in any field, as full use has been made of materials and machine elements which are familiar to everyone.

The De Bernardi unified control

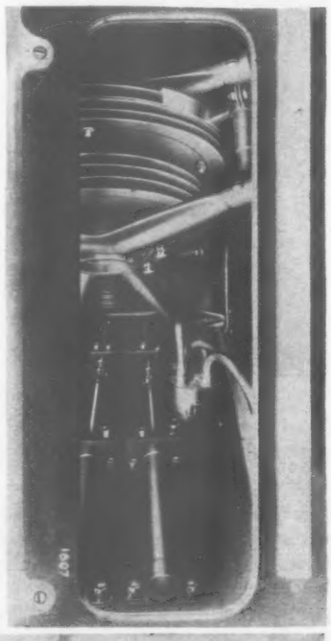
AN interesting feature of the new Caproni 97, single-engined semi-cantilever five-place cabin monoplane (500-hp. Jupiter engine), is the use of a combined control for rudder and ailerons. In this way, one set of the usual controls is totally eliminated, and the yawing and rolling motions are so synchronized that banked turns may be made by simply turning the wheel to the right or left. Longitudinal control, as in conventional types, is by fore and aft motion of the wheel. The horizontal stabilizer may be adjusted to keep the machine in longitudinal equilibrium for various conditions of load and power output.

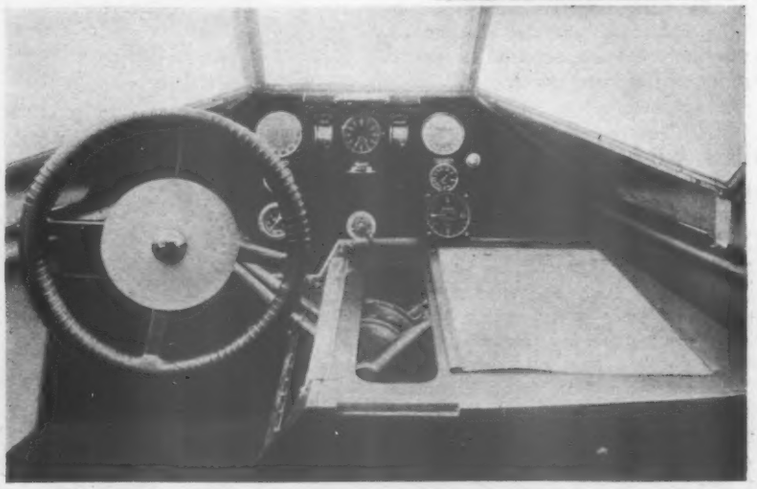
The cockpit of this airplane looks considerably less complicated than the average, and does not differ greatly from the driver's seat in an ordinary automobile. The steering wheel is at the left, control levers in the center, brake pedals are on the floor and an automotive type dashboard carries the instruments and their controls. The steering wheel rotates about a graduated disk on which are marked a datum line, parallel to the longitudinal axis of the airplane, and the degrees of turn to the right or left. The interconnection of the rudder and aileron is accomplished by cables and pulleys.

In addition to the synchronizing feature, the machine is said to be stable enough so that it will maintain normal flight under average conditions with completely locked controls. Springs introduced into the aileron and rudder control assist in restoring the plane to a normal attitude after a disturbance of any kind in the air.

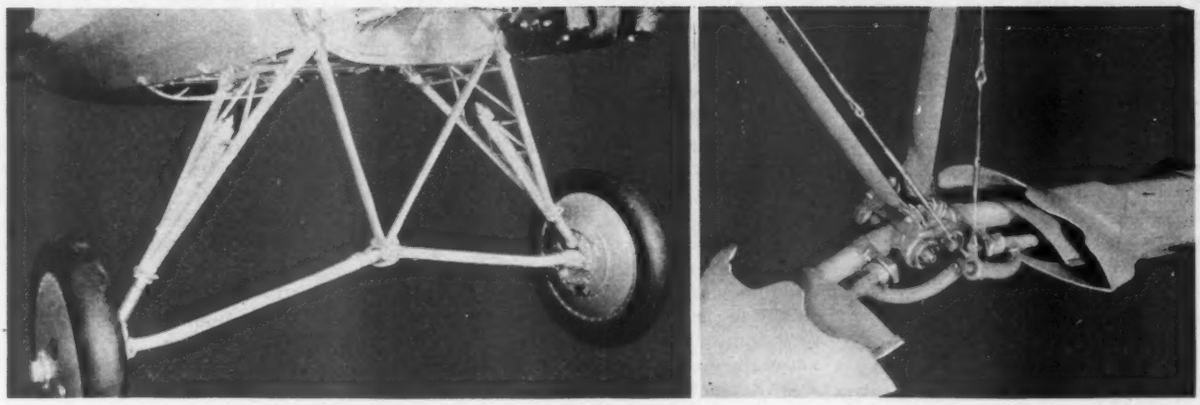
Use of ball bearings in landing gear

ON any airplane designed primarily for training purposes the undercarriage is one of the most imprtant units, and the useful life of the machine may very easily depend on the ability of the landing gear to stand up under the severe conditions which this usage ordinarily imposes. Even if it does not actually break down in service, the repair and maintenance charged against the landing gear may make the difference between profit and loss to the operator. The undercarriage of the new Consolidated Model 21-A Trainer (described on page 488) has been designed with this factor in mind. To a rugged primary structure have been added features which make for acces-





The control cockpit of the Caproni 97 and the combination control unit



The undercarriage assembly of the Consolidated Trainer. Right: Detail showing connection of axles at cabane, and brake rods

sibility and a minimum of maintenance.

In general, the landing gear is a modified split axle type in which the side members are hinged to the lower longerons, with the axles pivoted about the apex of a rigid inverted cabane structure below the fuselage. The main side members are built up of welded chrome-molybdenum steel tubes in the form of a relatively narrow vee. A special oleo-hydraulic shock absorber cylinder is welded to the tubes at the apex of the vee bisecting the included angle. Short tubular struts welded to the upper end of the shock absorber casing and to the main tubes of the framework hold the cylinder rigidly in place. The free end of the shock absorber plunger is attached to the axle fitting close to the wheel.

The most unusual feature of the whole design is the extensive use which has been made of ball bearings. The only points where they have not been used are at the main connections to the fuselage. All other joints, including the connections of axle and cabane, shock absorber plunger and wheel fittings, brake rods and controls, etc. are mounted on ball bearings which are moisture and dirt-proof, and which require lubrication only once during the life of the airplane. At the points where plain bearings are used, the load is carried on hardened steel pins which bear against bronze bushings. The latter are readily replaceable in case of excessive wear without disturbing the primary fuselage structure, and accessible Alemite fittings provide for their complete lubrication.

Wheel brakes are actuated through torque rods which lie parallel to and immediately behind the axle. Suitable brackets welded to the axle provide means of support. A universal joint provides the necessary flexible connection at the wheel, and the inner end of each tube is provided with a lever arm so bent that its free end comes in line with, and immediately behind, the central fitting of the cabane. The control cables are fastened to the lever arms through small universal ball bearings in special mountings and go up to the floor of the fuselage immediately behind the cabane struts. Good alignment of the cables and the struts is obtained by offsetting the two lever arms slightly to give each a chance to operate without interference from the other. Turnbuckles are provided in the cables to permit equalization and balancing.

Both vee shaped members and shock absorber units are completely faired by means of sheet aluminum housings. Inspection doors at an appropriate height give access to the air pressure valve on the shock absorbers. The cross-axles and brake torque tubes are enclosed in sheet aluminum fairings supported on small rib-like brackets attached to the axle. Specially shaped housings which are readily removable to provide access to the workings parts, cover the pinned joints not only at the cabane connection but at the point of attachment of the wheels. The entire undercarriage is thus faired to an unusual degree, and at the same time, accessibility has been very little reduced.

JUAN DE LA CIERVA AND THE AUTOGIRO

WINGS OF TOMORROW; THE STORY OF THE AUTOGIRO, *by Juan de la Cierva and Don Rose; Brewer, Warren & Putnam, New York; $2.50.*

TWO men were discussing the future of flying in this country. One was a cotton broker, the other a farmer. Considerable difference of opinion was expressed as to the rate of expansion, but both were in agreement on one point. They were sure that aviation's future rests with the autogiro, although neither knows anything of the theory of flight nor has either been closer to an autogiro than the sidelines of an airport, and they proceeded to discuss this latest aircraft with enthusiasm.

This latest addition to a growing list of papers, articles and books on flying reveals the early days of the Spanish inventor, Juan de la Cierva, a young engineer who was irrevocably bitten by the flying bug and sought avidly after practical experience in addition to his studies and experiments. But Cierva was more than an experimenter; he was a primitive, seeking his own paths of investigation and ignoring the dogmatic trend of design which left so much to be desired in contemporary airplanes. He was seeking an entirely new theory of flying.

Just because all airplanes had followed in the footsteps of the Wright Brothers, and designers had hitched their aerial wagons to the star with fixed wings was no reason for supposing that any other method of flying was impossible. Cierva persevered with *movable* wings, and immediately ran into difficulty with gyroscopic moment. The articulated blades of his auto-rotor proved to be the solution. From then on, progress was comparatively easy, and proceeded along the lines of adjustment, modification and development of the principle.

From the accounts of the start of autogiration in this country the book

shifts from biography to an exhaustive treatise on the possibilities of the autogiro as applied to the individual flier, the student, air mail, the airport and civic-center problem, speed and payloads, industry, and flying in the future.

The theory of the autogiro is carefully explained in one of the latter chapters, hinting at the great mass of aerodynamics which determine precisely the characteristics of a given autogiro before it is built. But it is written in a way that is readily understood by the nontechnician, and its inclusion seems to have been a happy inspiration on the part of the compilers of this book. James G. Ray, the well-known autogiro pilot, explains the machine and its flight characteristics from the pilot's viewpoint, also, while the closing chapters of the volume are devoted to testimony, tribute and praise from many prominent Americans as well as from the press.

No one will dispute, after reading this book, the wisdom of the N. A. A. in awarding the Autogiro Company the Collier Trophy "for the greatest achievement in aviation in Americe, the value of which has been demonstrated by actual use during the preceding year." —H. S. Mazet.

TWENTY YEARS OF FLYING

The Flying Dutchman, An Autobiography, *by Anthony H. Fokker and Bruce Gould; Henry Holt & Company, New York City; $3.*

"And for twenty years, after designing a plane, I flew it first myself." That is, in all ways, a remarkable statement. It could have been uttered in truth by only one man. Twenty years of flying can be claimed by a handful of men only; twenty years of designing planes by fewer still. Together they identify the speaker as unique—which is just what Anthony H. G. Fokker is, an increasingly apparent fact as his autobiography is read.

Dramatic in all respects the book certainly is, replete with an objective drama that makes good reading. But this volume does not delineate in poignant fashion the dynamic genius, the resourcefulness, the driving energy, the courage (except by inference) which indelibly characterize the man whose name has been formidable in flying circles since Curtiss won the Gordon Bennett Race at Rheims. However, Fokker the fighter is chronologically represented from boyhood to the business depression of the present in a manner which makes absorbing reading.

Flying and Fokker indeed grew up together. At first, his struggle was to keep flying, and without the aid of the hardy Dutch father who subsidized the pioneer aviator, Tony Fokker could not have spread his wings far enough to overshadow aviation at the far corners of the world as they do today. At the threshold of a successful business at last, the war broke. Instantly, swept up in the chaos of military necessity, the Fokker factory was ordered to produce airplanes for the front.

The astounding energy of the inventor, the efficient adaptability, the professed disinclination for money, the bewildering rapidity of success, once the magic formula was found, combine to produce an absorbing tale. There is a childlike naivete here and there which seems to be the product of uncolored dictation. Throughout, objectivity is maintained, giving rise to the feeling that those few friends mentioned are merely people who lived long ago and whose destinies really mattered little in the career of flying's devoted apostle.

A vivid personality may not have been created in these pages, but there is provided an unparalleled personal history of flying from the "inside." The early struggling days of famed birdmen live again, and the war in the air becomes realistic on a retrospective screen. Wright, Curtiss, Pegoud, Richthofen, and others of a distant day fly once more. Grass-cutting airplanes creak unsteadily through the early chapters, while in the mad days of the holocaust roaring engines and diving combat planes mingle with the incessant din of the overworked factory. Then comes the gigantic smuggling hegira across the Dutch border after the armistice and the expansion of peaceful air commerce. Thus we see the varying fortunes of the home-town boy who made good, and his world-famed airplanes.

Fokker is enthusiastic in his applause of Bernt Balchen. Balchen's ability and attainments have too long been hidden under the bushel of his extreme modesty; it was time that he be granted credit for his worth.

One inaccuracy is worthy of a lesser individual. In the closing chapter a list is given of some of the outstanding Fokker flights in various parts of the world. The 1930 flight by Wing Comder. Charles Kingsford-Smith in the (Fokker) Southern Cross is hailed as the first circumnavigation of the world by airplane. Why is it that chroniclers will persist in forgetting the pioneers who first blazed trails across uncharted skies? What about the Army's world flight in 1924?—H. S. Mazet.

INTERNATIONAL FLYING PROBLEMS

International Control of Aviation, *by Kenneth W. Colegrove; World Peace Foundation, Boston; 234 pages; $2.50.*

The relations of aerial navigation to international policy have been largely ignored by the American aernautical industry. It is not then very surprising, but it certainly is nothing for us to be proud of, that the first specialized treatment of the problems of international flying to be published in the United States comes from an author having no previous connection with aeronautics.

Professor Colegrove has approached his theme as a student of law. His book is not only the best existing treatment of aerial aspects of international law and policy, but it offers also the best existing brief summary of the state of commercial aeronautics and of the particular aeronautical policies of the great powers of the world.

A great part of the book, after the preliminary explanation of what commercial aviation is and how it has grown, is of course devoted to the International Convention for Air Navigation and the experiences that it had in applying it. The history of the formation of the Convention is excellent, although Professor Colegrove may be challenged on a few points.

Professor Colegrove, analyzing the Pan-American Convention drawn up at Havana in 1928, compares it with the C.I.N.A. greatly to its disadvantage, and makes general objections to the organization of air law on a regional rather than a world basis. The reviewer heartily agrees with his general conclusions, but feels that he is somewhat unjust to the Pan-American Convention in not taking account of the peculiar conditions under which it was drafted. It was to control traffic among a group of republics of every degree of culture, only one of which (the United States) had an aircraft industry of any considerable importance, and few of which were likely to be equipped for a thorough-going supervision of airworthiness requirements. Elaborate provisions vigorously criticized by Professor Colegrove were the almost inevitable result of this great disparity of conditions among the contracting states.

The book treats of private as well as public air law and goes at some length into the work of the C.I.T.E.J.A., culminating in the Warsaw Convention of 1929. It even covers entirely nongovernmental international activities.

One chapter is given to the subject of limitation of aerial armament. It shows a careful examination of sources, and it is perhaps the best study that has so far been offered in print in English, but on the whole it is the weakest part of the book and the most seriously open to the charge of factual error. Obviously, Professor Colegrove is not a military man. The military chapter, like all the rest of the book, is delightfully written, concise without being abrupt, forceful without conscious seeking after dramatic effect. This volume appears to be the first concrete expression of Professor Colegrove's interest in aeronautical matters. It is earnestly to be hoped that it will not be the last. —Edward P. Warner.

THREE FOR THE MECHANIC

AVIATION ENGINES, *by Ray F. Kuns; American Technical Society, Chicago.*

AUTHOR Kuns is principal of the Automotive Trades school of Cincinnati. He has designed his text for the use of graduates of automobile courses or for those who have already had considerable experience as automobile mechanics. A personal lack of such a background makes a judgment of its success a little difficult.

The treatment is of the individual case type. About a dozen engines are described, some on a single page, some to the length of fifteen pages or more. In no case is the text detailed enough to serve in the place of a manufacturer's manual for the particular engine under consideration, although the material is often reminiscent of such sources. Illustration is largely by photographs of the overall engines or of assemblies.

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AVIATION ENGINE EXAMINER, by *Major Victor W. Pagé; Norman W. Henley Publishing Company, New York.*

I HAVE never been much of an admirer of Major Page's books. If anyone had told me that I could read through a short, for him, text book of 450 pages on the question and answer principle, which the Major had written on aircraft engines and would thoroughly enjoy it, I would have been very cynical indeed. I therefore feel in an especially strategic position to claim that, the "Aviation Engine Examiner" is the best, and most useful, elementary textbook on aeronautical power plants which has yet been written in the English language.

In general terms, the subjects are the principles of combustion, engine types, engine parts and details, carburetion, ignition, and lubricating systems, fuel and oil, installations, auxiliaries such as starters and superchargers, propellers, instruments, trouble shooting and overhaul.

Presentation of the question and answer type often produces a dull book, but the author in this instance seems blessed with the faculty of asking himself interesting and pertinent questions, which is no mean feat.

The volume should be of use to all mechanics and pilots, in professional ground schools, and even in early engine courses in engineering universities. I wish it a wide sale and a reasonably long life.

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THE CARE AND MAINTENANCE OF AIRCRAFT; *Lt. Col. W. Lockwood Marsh, editor; Airways Publications, Ltd., London*

THIS slender volume is a collection of articles by seven different authors which appeared in *Aircraft Engineering,* the well known British publication. It was designed to furnish a theoretical background for those wishing to qualify for what corresponds to our aircraft mechanics ratings.

Its chief interest lies in the differences it indicates between the approach to the subject in the two countries.

A general perusal of the syllabuses of subjects covered in the examinations would indicate a rather heavy emphasis on aircraft materials rather than on the functional operations of repair usually stressed in this country. A knowledge of the installation and testing of instruments somewhat superior to what is common here is also required.

The volume under consideration is excellently written by a group of distinguished experts and is probably admirably suited to its purpose. So great however are the differences of aircraft design, operation, and even materials, that its direct applicability to American use will be necessarily limited.

The printing and binding is extremely attractive, but the use of only a half dozen illustrations throughout, lends an austerity to the text which is perhaps unjust.—DANIEL SAYRE.

THE ARCTIC AND ANTARCTIC

BRIEF HISTORY OF POLAR EXPLORATION SINCE THE INTRODUCTION OF FLYING; *by W. L. G. Joerg; American Geographical Society, New York; $5.00.*

THIS work shows evidence of copious and painstaking research on not only the territory covered by aircraft in exploration of polar regions by all participating expeditions but also other incursions without benefit of aircraft.

While it would be impossible to treat in detail in one short volume the polar expeditions from various nations which have made use of the airplane, the chronological history of aerial exploration in polar regions is here presented concisely and inclusively.

Since 1925 the world has experienced a revival of polar exploration, aided no little by the airplane and the airship. Aerial transportation routes, particularly in the Arctic, will inevitably receive international attention before many more years, so that possessions in polar regions will assume tremendous importance.

In the Arctic and Antarctic it is quite difficult at times to settle even the question of where "land" ends, due to the existence of great sheets of shelf ice such as exists in the Ross Sea. No solution of these problems is forwarded in this book, but they are presented briefly as a guide to existing conditions, contributing greatly to a better understanding of the attempts made to locate mineral deposits and discover the best short, intercontinent air routes, and aerial navigation factors and operations.

The maps presented in the closing pages round out a thoroughly informative work on the modern status of polar exploration with the aid of aircraft.—H. S. MAZET.

AN AERIAL ANALYSIS OF PERU

PERU FROM THE AIR, *by Lieut. George R. Johnson, former chief photographer, Peruvian Naval Air Service; American Geographical Society, New York; $5.*

PERUVIAN life for the most part adheres to the western valleys. There is but one railway (the highest in the world) across the cordillera of the Andes. There is also one road worthy of the name.

But aerial transportation answers a long-urgent need. There are 30 ports on the coast—each one with its own valley and mining district—which exist merely for the handling of freight. Valley, railway or road, and port form a complete and independent economic unit. There is no continuous railroad connecting valley to valley across the intervening deserts. Hitherto the great transportation trunk line has been the sea; it is rapidly becoming the air.

With nearly 150 aerial photographs Lieutenant Johnson has shown the present degree of transportation developments and how the airplane can extend them immeasurably. His book graphically depicts the natural barriers of the country, the extent of civic improvement in most of the important population centers, the huge acreage now going to waste which will eventually be reclaimed for agriculture by irrigation, and the imperative need of easy and swift transportation.

For a quick and comprehensive study of Peru and its transportation problems his book is ideal. A large and complete map of the country would be a welcome addition to the sectional maps and photographs of the book. Also, with many obliques and particularly with the verticals, it is extremely difficult to judge height and distance in the absence of comparative landmarks. By all means the altitudes trom which they were taken should have been included.—H. S. MAZET.

A HANDBOOK FOR PILOTS

STANAVO PILOT'S HANDBOOK; *Stanavo Specification Board; 1931; 88 pages.*

THIS vest pocket size publication, containing much information of interest for the aviator, is available without charge to all American licensed pilots. Copies have been mailed to the best available lists, but the publishers will send them to any who have been omitted. Radio code signals, airline distances between principal cities, maps, oil recommendations for various engines, and generous memorandum space are included.—LESLIE E. NEVILLE.

The Buyers' Log Book

Small floodlight

Designed for use where requirements do not necessitate larger standard floodlighting units, a new small size general utility floodlight projector has been announced by the General Electric Company of Schenectady, N. Y. The unit weighs less than 3 lb. and measures approximately 9 in. wide, 10 in. deep and 13 in. high. It is built for a 100-watt general service incandescent lamp. The housing is completely waterproof for outdoor service. —AVIATION, *August, 1931.*

General Electric small size floodlighting unit

A spring and ring tester

In automobile and airplane engine maintenance it is important that valve springs and piston rings be checked for proper compressive strength. In either case, weakness or excessive stiffness are causes of faulty operation and unusually high rate of wear on moving parts. A combination piston ring and valve spring tester designed to compare the strength of rings and to measure the compression strength of springs, has been put on the market recently by the Toledo Precision Devices, Inc., a subsidiary of the Toledo Scale Company, Toledo, Ohio. This apparatus, which is designated as the Auto-Gage, is adjustable to any size of piston ring, and measures the strength directly on the scale. The compression resistance of valve springs is also indicated directly. The Auto-Gage can be furnished either as a spring testing device, a piston ring testing device, or as a combined unit.—AVIATION, *August, 1931.*

Potentiometer

An instrument which is adaptable for the controlling of temperatures in furnaces of all types is being produced by the Brown Instrument Company of Philadelphia, Pa. The machine is a combination controller and recorder which not only maintains furnace temperatures at predetermined levels, but also draws a continuous time-temperature chart.—AVIATION, *August, 1931.*

Radio shielding

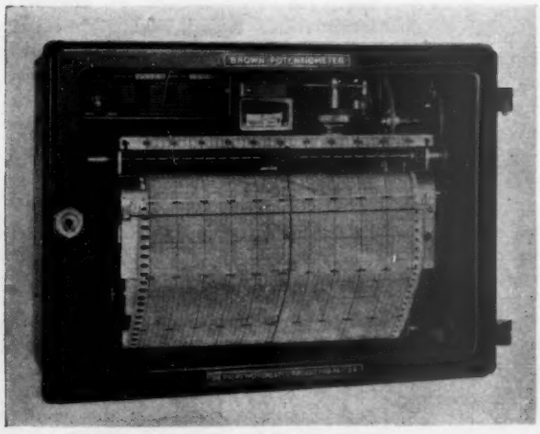
With the increasing use of radio on transport airplanes, it is essential that all sources of electrical disturbance be thoroughly shielded to prevent interference with reception. A new type of radio shielding for the ignition systems of Pratt & Whitney aircraft engines has been developed by Mr. Walter A. Hamilton, vice-president and chief engineer of the Aero Corporation of California.

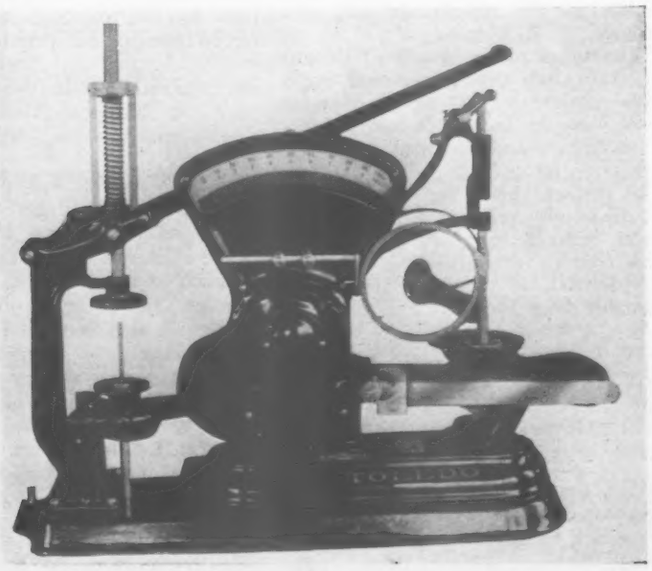
The Hamilton shielding is made up in two units interchangeable with the standard equipment supplied with Wasp and Hornet engines. It may be installed without removing the engines from the airplane and is so designed that it does not interfere with standard cowlings. By its use, approximately 20 ft. of standard exposed wiring on a Wasp engine is eliminated. The entire assembly is water and gas tight and is designed with an electrical safety factor of ten.—AVIATION, *August, 1931.*

"The Beaver Shop"

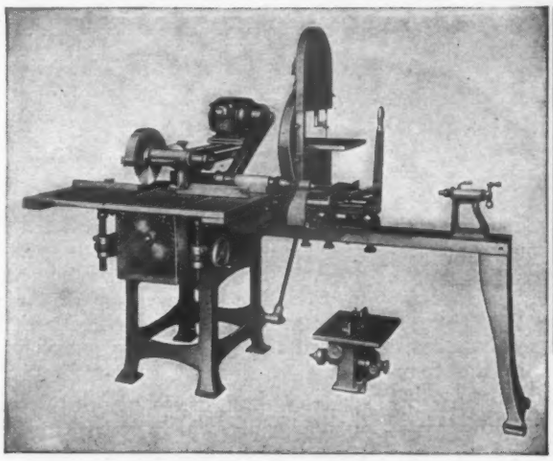
A combination woodworking machine known as the Beaver Shop, has been announced by the Porter-Cable-Hutchinson Corporation of Syracuse, N. Y., the manufacturers.

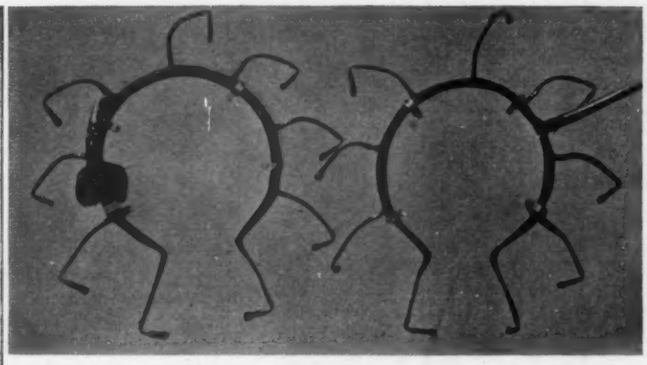
The tool includes an overhead cut-





Above: The Brown Potentiometer. Right: The Auto-Gage spring and ring tester





Above: Porter-Cable-Hutchinson "Beaver Shop." Right: Complete Hamilton radio shielding units for Wasp engine

off saw, table rip saw, jointer, band saw, lathe, shaper, mortiser, and boring attachment, and constitutes a complete woodworking shop in one machine.—AVIATION, *August, 1931.*

Welding blowpipe

Designed particularly for airplane fuselage, or other light welding work, a new welding blowpipe has been announced by the Linde Air Products Company, 205 East 42nd St., New York City. The blowpipe is 10½ in. long and weighs 10 oz. Six different sizes of standard tips are available. The particular advantage of the new blowpipe over older equipment lies in its compactness and lightness making it readily handled where fine and accurate work is required.—AVIATION, *August, 1931.*

Marker light

For outlining airport runways, a flush-type marker light has been produced by the Westinghouse Electric & Manufacturing Company, Edgewater Park, Cleveland, Ohio. The units are installed in the ground with the upper edge of the lens ring flush with the surface and therefore offer no obstruction to a plane passing over it. The maximum projection at the center of the lens is ¾ in. Lenses are sufficiently strong to carry the weight of a plane, and are supplied in several distinctive colors. The housing is of cast iron and is completely waterproof.—AVIATION, *August, 1931.*

Magnetic compass

The Elgin National Watch Company of Elgin, Ill., has announced a new magnetic compass for aircraft in which a new method of card suspension is employed to stabilize the compass against vibration. A coiled spring is interposed between the pivot and the other magnetically sensitive elements of the compass. Stabilization of the card is a result of the action of the spring and the damping afforded by a special liquid with which the bowl is filled. Compensating magnets are provided. The bowl, compensator housing and parts are made of phenolic composition. The instrument is designed for board mounting.—AVIATION, *August, 1931.*

Ignition switches

A complete line of ignition switches for airplanes equipped with two or more engines has been announced by the Delco Aviation Corporation of Dayton, Ohio, subsidiary of Bendix Aviation Corporation. These units incorporate an individual lever for controlling each engine and also a master switch to cut off all engines simultaneously. They are arranged in compact housings for instrument board mounting.—AVIATION, *August, 1931.*

Aircraft Products floats for light airplanes

Westinghouse motors

A unique idea in electric motor construction which should be of particular interest to small shops having motor-driven machinery has been announced by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. The new motors are made with the electrical and mechanical parts separated in such a way that if windings burn out the entire stator (including pole pieces and windings) may be removed from the frame and a new unit substituted. It is claimed that a motor may be repaired in this manner in about one hour when spare units are carried in stock.—AVIATION, *August, 1931.*

Pontoons

Designed especially for use with the light airplanes which are now becoming popular, the Aircraft Products Corporation of Detroit, Mich., has introduced a set of light-weight floats which can be readily attached to the standard landing gear without making extensive changes in the primary structure. The floats are so designed that the cross members usually found on larger models are eliminated, which decreases the head resistance on the water and in the air. The floats are of the conventional vee bottom, single-step design built of aluminum alloy. Hand hole covers give access to the several compartments, for simple deck fittings are provided for attachment to the airplane. The weights of each float is 37 lb.—AVIATION, *August, 1931.*

Immersion heaters

A series of electrically heated immersion heaters for warming up oils or other liquids is described by the General Electric Company of Schenectady, N. Y., in its Bulletin G.A.-

214-B. These units are put up in a wide variety of forms, applicable to a number of industrial processes, among which is the pre-heating of lubricating oil for cold weather operations of aircraft engines.—AVIATION, *August, 1931.*

Navigation light

A new series of the Type 554 navigation light has been announced by the Pioneer Instrument Company of 754 Lexington Ave., Brooklyn, N. Y. The units come in a variety of forms, designed for use on wing tips, rudders, etc. and are designed for ease in installation and maintenance, and low parasite drag. All lenses are glass, and are held in place by spring snap rings.—AVIATION, *August, 1931.*

Catalogs

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United States Steel Corporation. Stainless and heat-resisting steels for all purposes are fully described in a new bulletin issued by the United States Steel Corporation. Numerous illustrations of typical applications supplement the detailed description and specifications of the various alloys.

The Lincoln Electric Company. Complete equipment for electric arc welding is covered in bulletin 3304, issued on Feb. 1, 1931, by the Lincoln Electric Company of Cleveland, Ohio. The booklet covers not only welding machinery and tools, but also face masks and safety clothing for the protection of the operator.

George Parnall & Company. An elaborate bulletin describing the Parnall Parasol Monoplane has been received from George Parnall & Company of Park Row, Bristol, England. This machine, which has been designed primarily for use as a full scale aerodynamic laboratory, and includes built-in dynamometer equipment, is described in detail and performance data are given. Three inserts showing side, plan and front views of the machine are included.

Durabuilt Steel Locker Company. Standardized steel lockers and tool cases suitable for use in manufacturing plants and airport shops are described in a bulletin entitled "Steel Locker Equipment for the Modern School Shop" issued recently by the Durabuilt Steel Locker Company of Aurora, Ill.

Caterpillar Tractor Company. Issue No. 57 of the Caterpillar magazine shows a number of interesting applications of tractors built by the Caterpillar Tractor Company of Peoria, Ill. Machines of the type illustrated have been used in the preparation and maintenance of airports and airport approaches.

Side Slips

By ROBERT R. OSBORN

MESSRS. Post and Gatty certainly have aroused our complete admiration for all features of their flight save one detail,—the name they selected for their good plane. Just think of the millions of dogs, trained seals, outboard motorboats, cats, shacks in the country, canoes, children and parrots that are going to be named "Winnie Mae."

It must be tough for the new students, whose chief interest in flying is the flossy uniform, with helmets, goggles, riding boots, and all that, to have a couple of men fly around the world in record time without hats and wearing only business clothes.

Mr. W.J.T., Jr., of Boston, Mass., found an item in the Boston *Post* which shows that the boys learned a trick or two on their flight around the world:

"LANDS PLANE SO NONE WOULD BE HURT. Roosevelt Field, N.Y., July 1 (AP)—When Harold Gatty, the Winnie Mae's navigator, saw where the crowd was placed, held in by 150 policemen, he dropped his right wing and slid to within a few feet of the ground. Straightening out then, he dropped the big plane gently onto the field facing away from the crowd so there would be no slightest possibility of injuring any of the over-enthusiastic welcomers."

Speaking of over-enthusiastic welcomers, it is unfortunate that so many record flights have to be made from or to Roosevelt Field, N. Y., or rather, it is unfortunate that such an excellent field should be within the district of the Nassau County Police. So many great aviation achievements have taken place at that field or nearby fields and the Nassau County Police have hardly missed an opportunity for their great fun of beating up the people who were interested enough in the event to turn out to see it. The following incident which we witnessed is a good example of their methods. When Lindbergh returned from his Paris flight he landed at Mitchel Field in a pursuit, transferring to an amphibion which landed him in New York harbor. An accredited newspaper photographer was running along intent on getting a picture of the landing. He was run into from behind by a police officer on a motorcycle who wasn't even looking in that direction. The photographer was sent sprawling and his camera damaged, and as he picked himself up said to the officer: "Why didn't you look where you were going with that?" The police captain who had also witnessed the incident ran up and said, "Is that man arguing with you? Throw him off the field!" The last we saw of the poor photographer he was being hustled off toward the gate by two patrolmen.

Mr. W.R.H. of New York City, mails in a clipping which gives a good explanation, at last, for the delays encountered by the Dornier Do.X on its trans-Atlantic flight; they must be redesigning it completely: "TEMPEST HOLDS DIRIGIBLE DO.X IN HER HANGAR." Schenectady (N. Y.) *Gazette.*

"The mail plane passed overhead; they heard the strong singing of the engine, the beat of the great wings——," from *Cosmopolitan* for July.

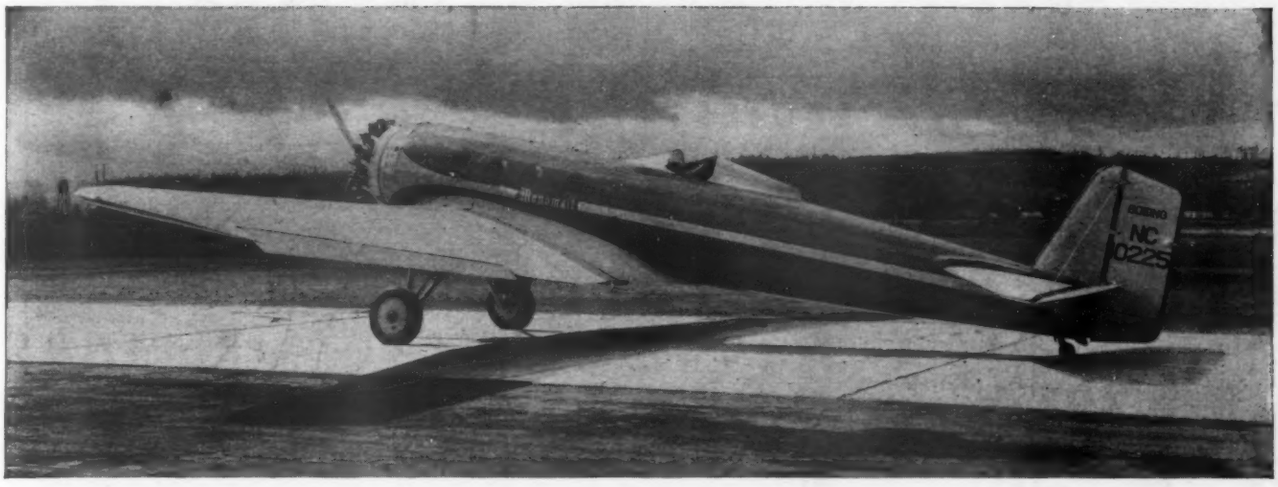
Mr. T.G. of Chicago suggests the following logical ending for the sentence: "Wham! And another caterpillar bit the dust."

The following letter, originally addressed to "Rusty" C, was mailed in to us by Mr. R.S.D. of St. Louis. We reprint it because the writer appears to be about in the state of mind most of us are, from trying to settle our own aviation problems:

"Dear Sir: I've found it very hard to convinse any person or party! But will keep on trying. I have a small wood form made of an Idea, Which I know that the world wants today. I have not filed for patent on same. And wish not to do so if any organization wishes to take hold of same and allow me commission. I think it rather funny that firms don't investigate. Its a small attachment that will when adjusted cause a aeroplane to lift and come down slowly, travel slow. At any time. If so wishes. Plane is under controll at all times under any condition of weather. A Tail spin has or is impossible. These things I can guarante and if I fail there is no harm done by investigation. I need help in this matter. And you may need it too before we get done with it. I so wish that some one would tell me the right thing to do. I'm no pilot never flew a plane. But have my way of thinking Consirning them. And don't think I fail. Let's hear.

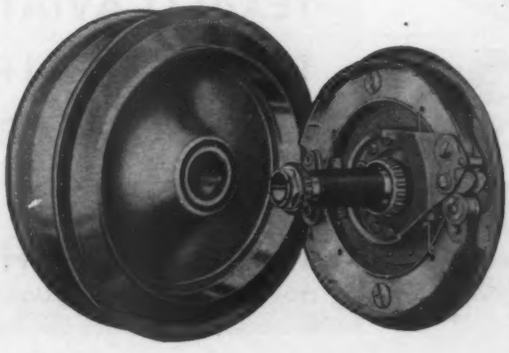
P.S. This letter is for any person whom can guide me correctly. give me some protection, which had to be a written contract."

That one sentence "I so wish that some one would tell me the right thing to do" would make a good slogan for the whole business just now.

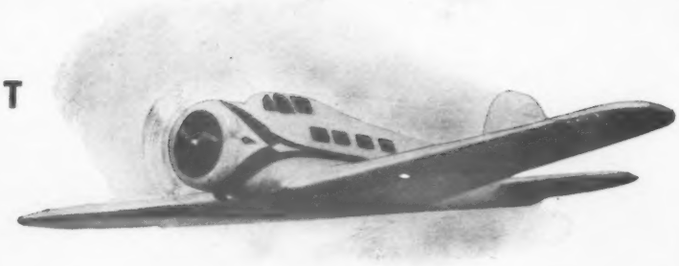


Timken has 18 Bearings on the Boeing Monomail

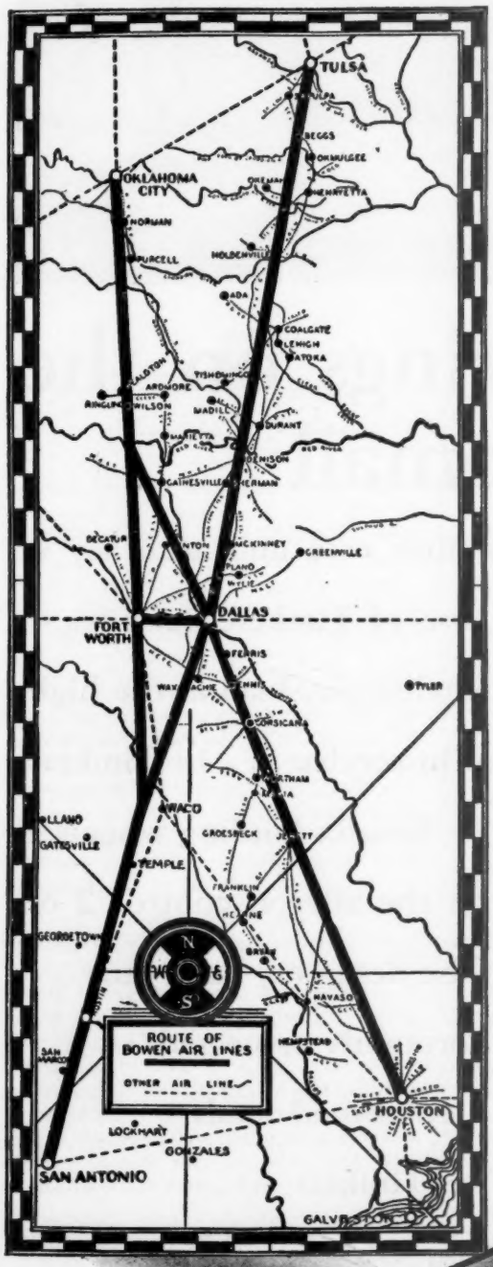
Advanced interpretations of efficiency, dependability, ease and accuracy of control and safety, are seen in the progressive use of Timken Bearings in this aircraft, which, its builders say, carries the heaviest pay load at the highest cruising speed of any single-engined airplane in service . . . 18 Timkens are installed at the following vital points: 4 in the Bendix landing wheels, 8 in the landing wheel retracting mechanism, 2 on the aileron control, 2 on the control stick and 2 in the tail wheel . . . The designers have thus not only conquered friction, but have thoroughly protected their ship against radial, thrust and combined loads as well. Specify Timkens. The Timken Roller Bearing Co., Canton, O.



THE WORLD'S SPEEDIEST



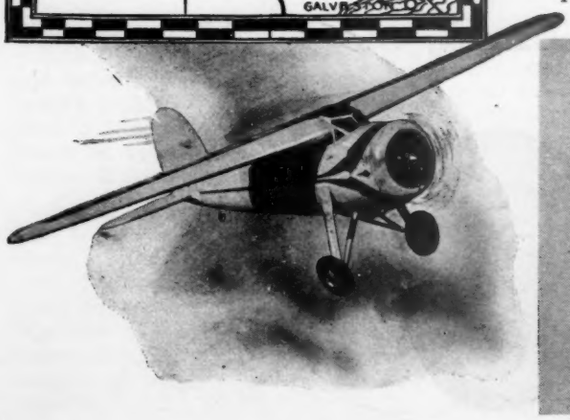
COMMERCIAL AIR LINES
fueled and lubricated
by TEXACO



THE Bowen Air Lines, Inc., with four commercial passenger lines between cities of Texas and Oklahoma, operate 18 daily scheduled flights regularly over the four routes. It is the first 175 mile-per-hour passenger service in air history and the fastest scheduled air-line operation in the world. • Lockheed Vega and Orion planes are used covering about 4500 miles per day. Texaco Aviation Gasoline fuels all the planes and Texaco Airplane Oil and Texaco Marfax Grease are the lubricants. • It is 100 per cent Texaco with the Bowen Air Lines. Nothing less than super-quality products would serve. • The Texas Company in developing special airplane fuels and lubricants, and in its furtherance of commercial aviation, the test and service flights of its own planes and the record-breaking flights of Captain Hawks, has done more, perhaps, than any other oil company to advance the certainty of fast scheduled air transportation. Texaco Aviation Products are distributed at airports throughout the country.

TEXACO
REG. U.S. PAT. OFF.

THE TEXAS COMPANY, 135 East 42nd Street, New York City



TEXACO AVIATION GASOLINE
TEXACO AIRPLANE OILS
TEXACO MARFAK GREASES
TEXACO AERODIESEL FUEL
TEXACO ASPHALT PRODUCTS
[FOR RUNWAYS, HANGAR FLOORS AND APRONS, AND DUST LAYING]

HOW ABOUT THE PRICE of Airwheel Safety?

If you think that you can't afford the extra safety that Airwheels give to your ship and pilot—here's a surprise for you.

For several months now the cost of Goodyear Airwheels and the new Airwheel roller bearing brake has been about the same that you'd pay for ordinary wheel and tire equipment.

You pay no heavy premium for the protection of real low pressure — which only Goodyear can give you — the protection of great soft pillows of rubber which roll over mud, sand, snow or ploughed ground.

You pay no heavy premium for brakes so sure, so smooth, so powerful in their action that they will "stop on a dime."

Maybe you think you don't need such equipment for ordinary landings. Maybe it's a fact that you don't.

But when you *do* need them—it may save the price of a good ship to have them on.

Only Goodyear can give you Airwheel safety. Why take chances with less protection?

For full proof of what Airwheels can do —write to Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

When you buy a new ship specify Goodyear Airwheels

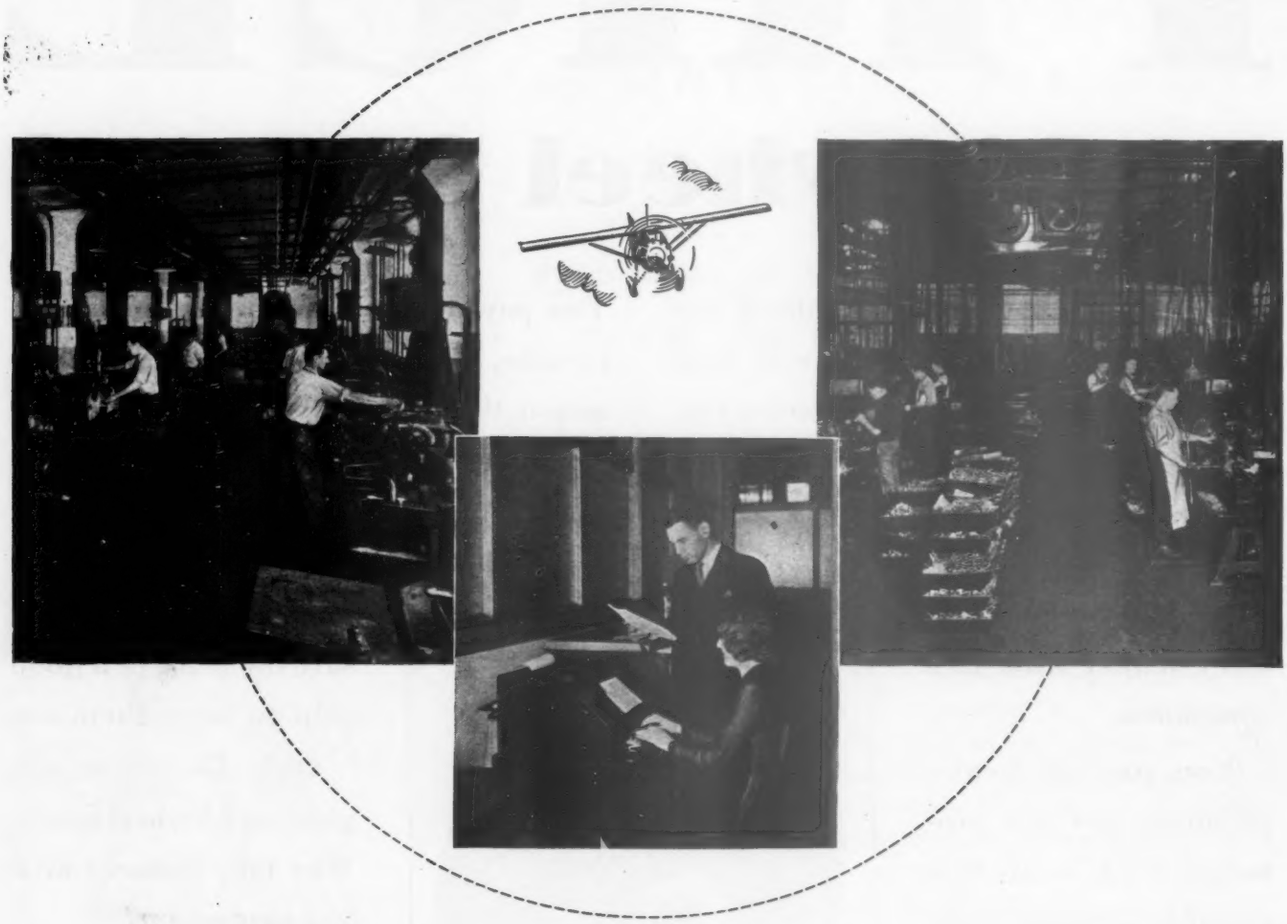
GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE

THOMPSON PRODUCTS, INC., MANUFACTURERS OF AIRCRAFT VALVES, USE

TELETYPEWRITER SERVICE

TO CONNECT THEIR CLEVELAND AND DETROIT PLANTS



THOMPSON PRODUCTS, Inc., produces a wide range of aircraft valves. To maintain a high standard of production efficiency, Teletypewriter Service* is used extensively for communication between their Cleveland and Detroit plants.

Typewritten messages covering every phase of the business are transmitted instantly, accurately and in private—administrative instructions, sales, accounting, traffic, specifications, messages to jobbers, engineering details, production, delivery dates, changes in orders.

Typists in both offices operate the machines and find them as easy to operate as any typewriter. As soon as an official dictates a message, his stenographer types it to the distant plant, receives any necessary reply, and brings it immediately to the official. Thus he has his answer in typewritten form within the space of minutes.

"Teletypewriter Service affords perfect coordination between all units," an officer says. "It improves efficiency and helps build customer confidence."

This modern business aid is equally effective, whether it connects airports stretching across the country, factories in different cities, or separated departments in the same building. Your local Bell Telephone Company will gladly show you how it might be of value to *your* firm.

* * *

**Teletypewriters are installed in the separated offices of private business concerns by the Bell Telephone Company. They are directly connected in such a way that a message typed on one is reproduced at the same moment in identical typewritten form by any or all machines on the circuit. The service may be had for any number of hours each day, from one upward.*

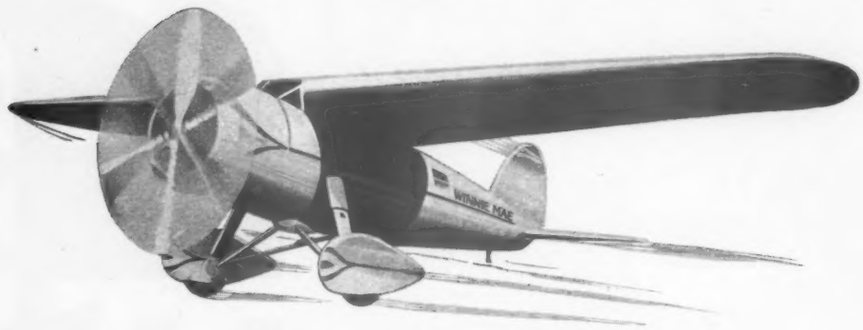
Before You buy...fly a KINNER POWERED SHIP.

THREE SIZES • ALL 5 CYLINDERS • 100 H.P. • 125 H.P. • 210 H.P.

95 Airplanes powered with Kinner Motors carry Approved Type Certificates. Among these are Pitcairn Auto-giro, Waco, Fleet, Curtiss-Wright, Bird, Savoia-Marchetti, Arrow, States, Air Transport, Lincoln, Kitty-Hawk, etc.

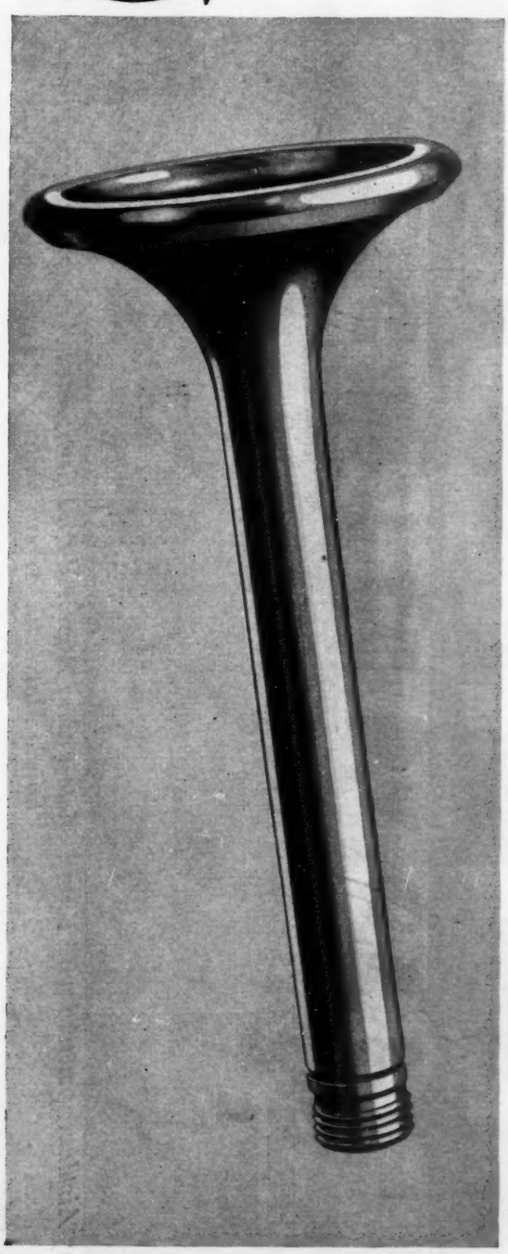
FAMOUS FLIGHTS WITH THOMPSON VALVES

This advertisement is one of a series recalling historic airplane flights in which Thompson Valves were used.



Circling the Globe in 8½ days

with the "WINNIE MAE"



They checked the valves at Fairbanks—and found they needn't have bothered. That was near the end of the 15,000-mile trail that was blazed around the world by the Wasp-powered Lockheed Vega "Winnie Mae" between June 23rd and July 1st. For seven days those Thompson valves had helped to keep its motor roaring across the Atlantic . . . Europe . . . Russia . . . Siberia . . . the treacherous Bering Straits. Just 36 hours later it was back at its starting point, Roosevelt Field, with the same valves still functioning perfectly. Never a miss from that motor throughout the entire astounding trip. Not the slightest loss of valve efficiency. Add this latest achievement to the long list of record-breaking flights which Thompson Valves have helped to complete, and you will understand why leading manufacturers and pilots insist on Thompson dependability for every aircraft engine need.

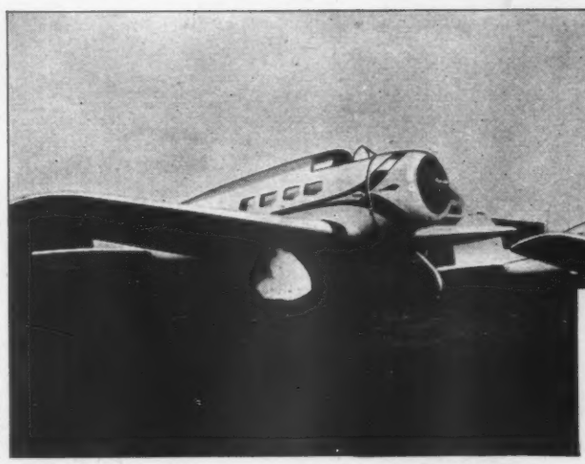
THOMPSON PRODUCTS, INCORPORATED

General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

Thompson Valves

KENDALL HAS THIS HABIT

4000 MILES DAILY FOR PITTSBURGH AIRWAYS WITH AN UNBROKEN RECORD OF LUBRICATION EFFICIENCY



Two units of the Pittsburgh Airways Fleet—Lockheed-Orion 6-passenger planes, Kendall lubricated.

Theodore Taney, Vice-President in Charge of Operations.

MODERN transport companies have found by actual results over long periods that Kendall Oil keeps motors on the job, planes in the air and schedules on the clock. That is the kind of service that tells its story on the profit side of the ledger of the transport line.

Mr. Theodore Taney, Vice-President of Pittsburgh Airways, Inc., gives an example of Kendall performance that will make profitable reading for airline operators everywhere:

> "This Company has been operating between Pittsburgh and New York for the past two years, and during that time we have never had any sort of motor trouble directly traceable to lubrication.
>
> We have never used any oil but 'Kendall' and have found it most efficient and reliable under varying weather conditions. During the Summer our temperatures run from 70 to 95 degrees and in the Winter as low as 20 degrees below Zero. Your oil does its work regardless of the heat or cold.
>
> Our daily mileage at the present time is slightly over 4000 miles, but we have the same confidence in Kendall Oil, and feel that it will go far towards making Speed with Safety a reality."

The Bradford Grade of Pennsylvania crude oil, from which Kendall is refined exclusively, commands a premium price—for good reason. Kendall Oil will give a full thirty hours of flying service without the necessity of change—by merely maintaining the oil level.

For complete details on Kendall Oil and a list of airports where it is sold, address, Kendall Refining Company, Bradford, Pennsylvania.

PENZBEST KENDALL MOTOR OILS

KENDALL OIL REFINED FROM 100% BRADFORD GRADE OF PENNSYLVANIA CRUDE

Use the Air Mail!

BONDED *and* SHIELDED *for* RADIO!

Curtiss-Wright SEDAN

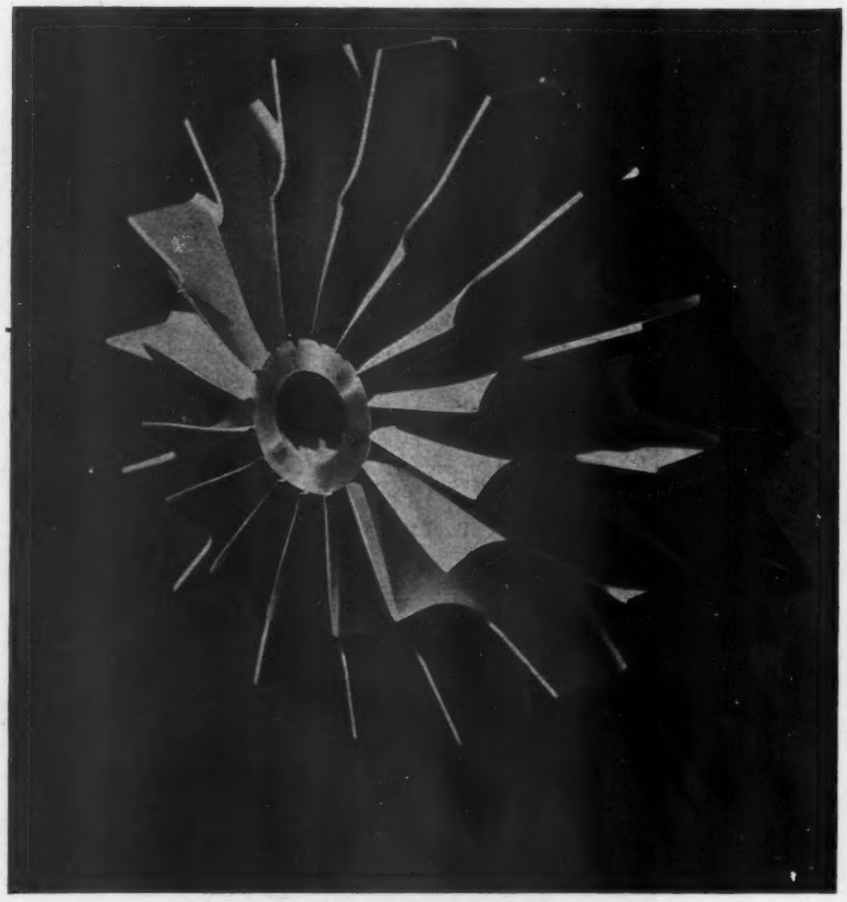
"That's fine, all clear ahead"

Dark clouds—thick weather all around—it's a grand and glorious feeling when you have a radio and don't have to guess what's ahead. The new Curtiss-Wright SEDAN is carefully bonded and shielded for clear radio reception and strong transmission—a safety factor which you have a right to expect in your modern cabin plane. It is typical of the many safety factors which Curtiss-Wright designers and engineers have incorporated in the SEDAN. There is safety, too, in the clear vision in all directions resulting from the shatter-proof glass windshield carried into the leading edge of the wing; in the low-swing position of the engine; and in the absence of outrigger struts. An entirely new wing curve insures slow, safe landing. The famous Travel Air Hydro-Flex landing gear minimizes the danger of rough fields. Internal expanding brakes effect easy and positive ground control. A welded fuselage of the finest steel, and controls actuated thru ball-bearings, add immeasurably to your feeling of security. Thoroughly advanced in its safety factors, this new 4-place cabin plane is equally superior in its clean, smart lines, in its luxurious comfort and convenience, in its economy and in its nearly two-mile-per-minute performance when powered with any of three famous air-cooled engines. Compare it point by point with any plane of its type or price and you will understand why this striking SEDAN is making new friends every day.

PRICES:
Fly away factory
185 *H P Challenger Powered* $4595
210 *H P Kinner Powered* $5100
240 *H P Whirlwind Powered* $9600*
**De Luxe Model*

CURTISS-WRIGHT AIRPLANE COMPANY
ROBERTSON MISSOURI

EVERY PRATT & WHITNEY ENGINE HAS A G-E SUPERCHARGER



THE remarkable dependability of Pratt & Whitney engines has been demonstrated time and again — in regular transport service, in military maneuvers, and in record-breaking flights. This performance pays high tribute also to General Electric superchargers — used in all Wasp and Hornet engines to obtain greater horsepower per pound of weight and better vaporization and distribution of the fuel mixture. ● The success of this General Electric product has resulted in an increasing demand for more supercharging.

THE General Electric supercharger consists of an impeller, or wheel, located in a specially designed passage between the carburetor and the intake manifold. It is usually driven by gearing to the crankshaft of the engine. ● In contributing to the performance of dependable engines, the G-E supercharger is having an important part in the progress of aëronautics. Your interest in General Electric products is invited. General Electric Company, Schenectady, N. Y.

The General Electric engine-temperature indicator is especially desirable for use with supercharged engines

700-12

GENERAL ELECTRIC

AËRONAUTIC EQUIPMENT

W

hat!

increase our appropriation in August?

It's an old custom with many manufacturers to curtail advertising when summer comes round. What they say in effect is, "We hereby notify everybody that we do not expect to do business during the vacation period."

But we believe advertising is a 12 months' operation for every company that keeps salesmen on the job the year round. We believe the company that can afford to let up in the summer can afford to let up in October and January.

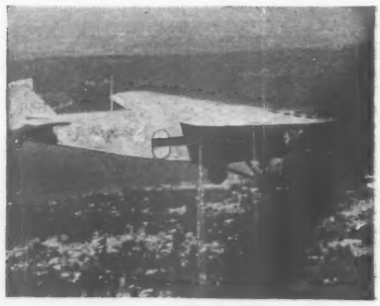
We believe, too, that the business man, the merchant, the engineer is going to read his business paper more than ever this summer. The reason must be obvious to anyone who knows what business is doing now to make short cuts to profits.

Because we really believe these things, McGraw-Hill increased its advertising appropriation to launch a supplementary campaign in business publications just as summer began.

In other words, we are notifying business men who use advertising and business men who ought to use it that we are not only open for business in the summer but that we are going out after it. These advertisements tell *what business paper advertising can do for you right now.* They point the way for you to *invest* your money in business publications for effective results.

Salesmen never needed hard-hitting advertising more than they do now. Give them help. Increase your advertising at once. Your advertising manager or agent knows how. Get him at work. Orders won't wait.

AVIATION
A McGRAW-HILL PUBLICATION
Tenth Avenue at 36th Street, New York, N. Y.
MEMBER A.B.C.



FAIRCHILD AERIAL SURVEYS, INC.

LET YOUR PASSENGERS KEEP IN TOUCH WITH THE WORLD ...BY POSTAL TELEGRAPH

MAKE EVERY PLANE A POSTAL TELEGRAPH OFFICE

People don't like to be out of touch with the rest of the world when they travel...they don't like to travel "blind". They're accustomed to telegraph their reservations...appointments...all kinds of messages when they travel. After all, why should they be deprived of communication facilities aboard the plane that they enjoy on a railroad or a ship?

No reason at all. Particularly not, since you can make your planes Postal Telegraph Stations without cost to your company. All you need do is to place a supply of Postal Telegraph blanks in each plane and instruct the attendants to file passengers' messages at terminal points.

Your passengers will like this service. It's a thoughtful service. It's a progressive move for you to make. It's something passengers will remember favorably...and tell their friends about, when they recall their trip.

By furnishing your planes with Postal Telegraph blanks and making provision for the filing of passengers' messages at terminal points you make your planes very definite links in the Postal Telegraph organization. You put your passengers in regular reach of 70,000 places in the United States and 8,000 in Canada. And more than that, you put them in reach of the entire world through the perfectly coordinated telegraph, cable and radio communication facilities of the International System of which Postal Telegraph is a part.

Today wire collect to Postal Telegraph headquarters in New York for more details of this service. A Postal Telegraph Representative will call.

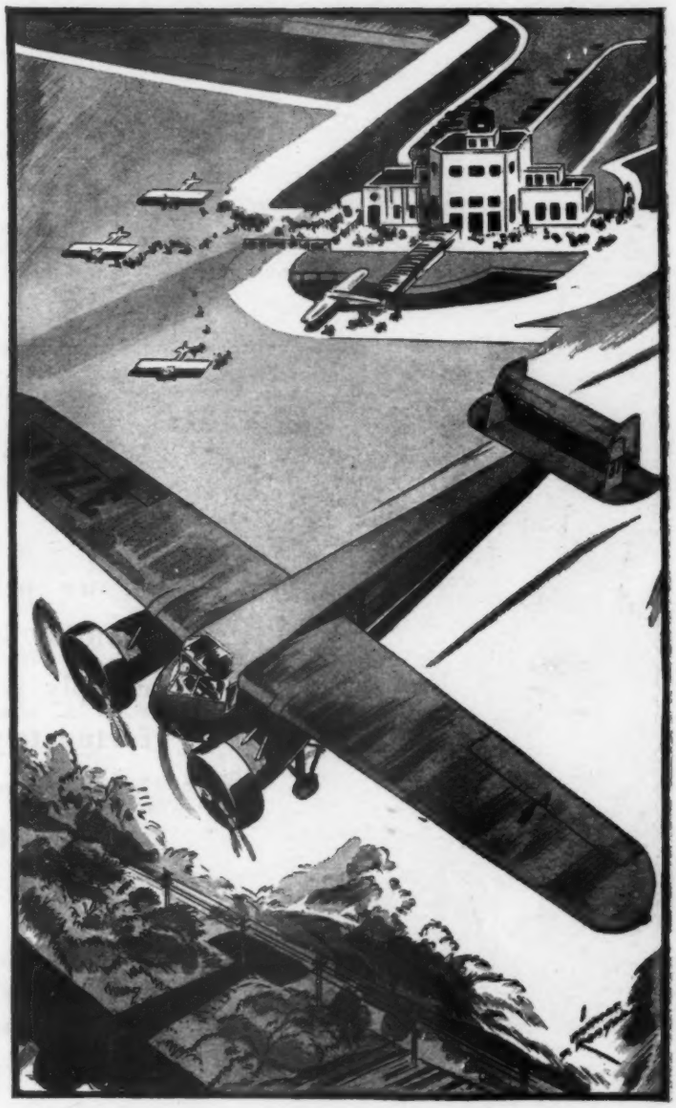
Postal Telegraph is the only American telegraph company that offers a world-wide service of coordinated record communications under a single management. Through the great International System of which Postal Telegraph is a part, it reaches Europe, Asia, The Orient over Commercial Cables, Central America, South America and the West Indies over All America Cables, and ships at sea via Mackay Radio.

THE INTERNATIONAL SYSTEM

Postal Telegraph

Commercial Cables — *All America Cables*

Mackay Radio

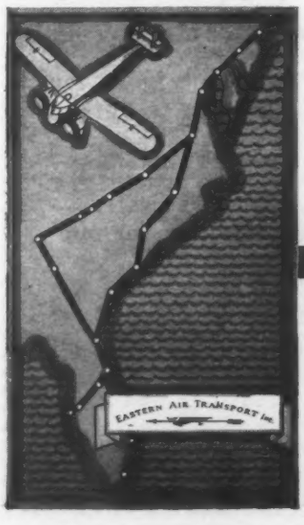


Wright Engines

Flew Hillig and Hoiriis to Europe, June 24-25, 1931 . . . fly Eastern Air Transports *daily* . . .

New York to Copenhagen of course, for more Wright Engines have made the North Atlantic hop than all other makes combined. Daily flights between New York and Miami, too, because Wright Engines top all records for long, dependable service. ◉ Speed and Stamina are Aviation's stock in trade. The eight Curtiss-Wright Engines provide both. The mighty "Conqueror" and "Challenger" . . . the renowned "Cyclones" and "Whirlwinds" . . . the sturdy 90 h. p. "Wright-Gipsy" invariably show a high percentage of power over and above the rated output. ◉ Spectacular ocean hops and the gruelling grind of daily transport service only serve to spur Wright engineers to keep Curtiss-Wright Engines ahead of Aviation's need for power. That they achieve this is revealed in striking developments in cooling, in carburetion manifolding, in the use of more efficient metals and in other improvements that continuously give each Curtiss-Wright Engine a standing unapproached by any other engine in its class.

"Along America's Oldest Highway"



WRIGHT

AERONAUTICAL CORPORATION

PATERSON, NEW JERSEY

A DIVISION OF CURTISS-WRIGHT CORPORATION

Do you know that . . .

each month our subscription department receives more than 150 requests for "Back" issues of AVIATION?

◆ ◆ ◆

If we printed extra copies of our monthly issues, we would be glad to comply with these requests, but unfortunately we have no way of knowing in advance just how many of our newsstand readers will "miss" an issue.

◆ ◆ ◆

But We Do Know **— that each of these requests indicates a reader has "missed" just the issue he could make valued use of.**

Insure your receiving AVIATION *regularly by filling in the coupon below, today . . .*

AVIATION
10th Avenue at 36th Street
New York City

◆

Subscription Rates:
U. S., Canada and Mexico, $3;
Central and South America, $6;
all others, $8.

Here is my check for $3.00. Send me Aviation for one full year.

Name .....

Address .....

City and State .....

Nature of Activity .....

COMBAT...
is the name!

...a name that marks a new and higher quality in aviation products.

COMBAT...Richfield's Aviation Gasoline meets U. S. Army specifications for fighting grade...and exceeds the requirements for everyday commercial flying by a wide margin. It gives you a "fighting kick" for your ordinary flying.

COMBAT has a high octane number, with a high anti-knock rating, low vapor pressure, unvarying uniformity, freedom from sulphur, corrosive matter and gum.

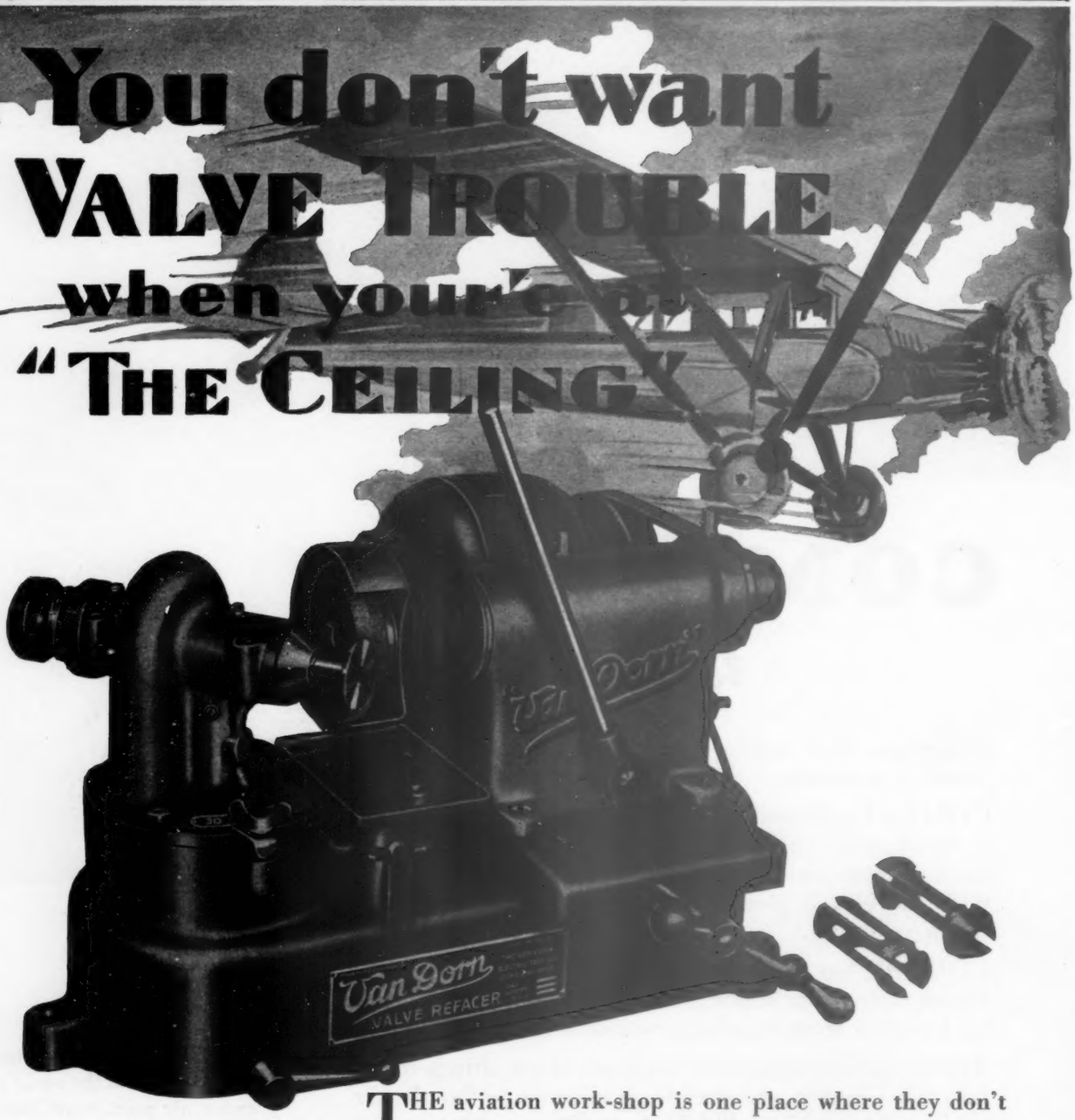
Translated into everyday language, these things mean increased power and speed, quicker take-offs...better performance under all flying conditions. And...at no extra cost over ordinary aviation gasoline! You can get COMBAT aviation products at leading airports both east and west of the Mississippi.

672 U. S. Army planes ...participating in the world's greatest air meet, over New York City...used COMBAT Ethyl Gasoline and COMBAT Richfield Aviation Oil...in gigantic eastern maneuvers.

COMBAT
Richfield's Aviation
GASOLINE

RICHFIELD OIL COMPANY ✣ LOS ANGELES ✣ NEW YORK CITY

You don't want VALVE TROUBLE when your ship is "THE CEILING"

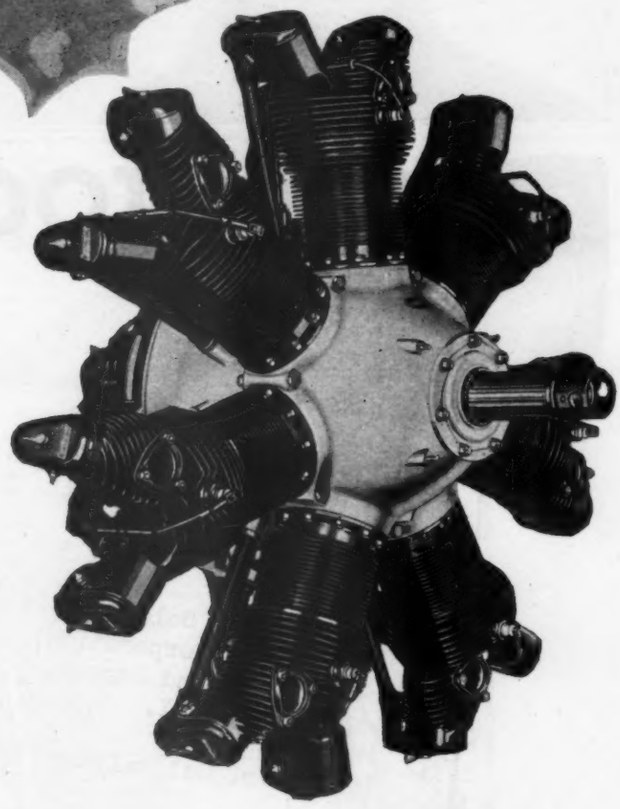


THE aviation work-shop is one place where they don't take chances. Particularly when it comes to maintaining the air-worthiness of ships. That's why you find Van Dorn Aircraft Valve Refacers on the job at airports throughout the country, doing their bit to keep aircraft engines in condition to fly "high, wide and handsome." Real precision grinding machines with ball-bearing wheel shaft and "twin-grip" collets for chucking valves accurately. Work-head can be rotated from 0° to 90°, accommodating all valve angles. Such smooth, easy operation! Does a real job—the kind of a job the veteran airman likes and wants. Why not learn more about Van Dorn Aircraft Valve Refacers? Write for catalog of complete line.

Buy from Your Distributor

"Van Dorn"

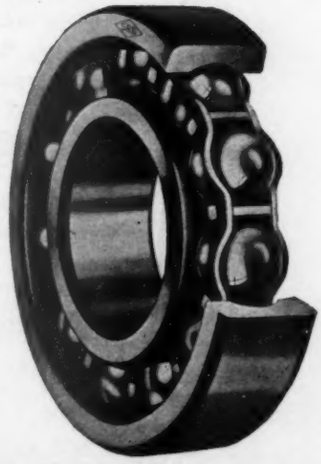
ELECTRIC TOOL CO.
TOWSON . . . MARYLAND



Still Another Endorsement of SRB Aviation BALL BEARINGS

• Shown here is the CONTINENTAL AIRCRAFT ENGINE, A-70. This 165 horse-power product of America's largest exclusive Motor Manufacturer includes among its features SRB Aviation Ball Bearings. Thus does another famous Motor Manufacturer endorse the performance qualities of the SRB Aviation type.

• Whether for radial loads on the crankshaft, enormous thrust loads in the propeller position, or for the punishment inflicted on rocker arm bearings—SRB Ball Bearings are the predominating choice of the Aviation Engineer.



STANDARD STEEL AND BEARINGS INCORPORATED
DIVISION OF MARLIN-ROCKWELL CORPORATION
Plainville *Connecticut*

Ball SRB Bearings

B G TOOK THE WINNIE

NEW YORK, N. Y.
July 7th, 1931

Mr. August Goldsmith, President,
The B. G. Corporation,
136 West 52nd Street,
New York, N.Y.

Dear Mr. Goldsmith:-

We wish to take this opportunity to advise you that we were very pleased with the performance of the B. G. Spark Plugs which we used in our Lockheed plane, the Winnie Mae, on the Round-the-world flight.

They functioned perfectly, and we are very glad that we had them on the engine.

Sincerely,

Wiley Post
Harold Gatty

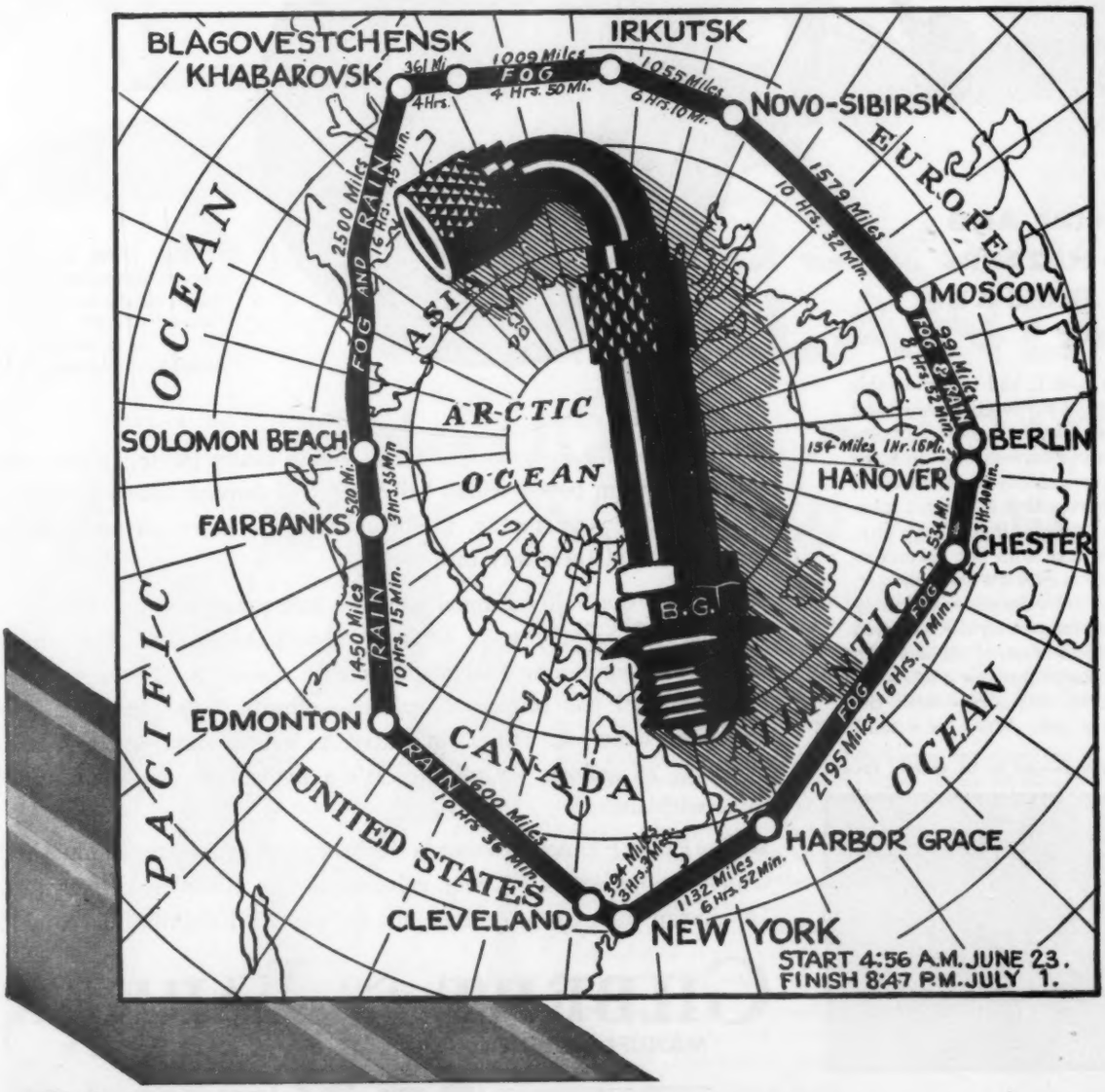
THE B. G.

136 WEST 52nd STREET,

Cable Address:
Golsteco, New York

B. G. 4B-1 Radio Shielded Spark Plugs were used by Wiley Post and Harold Gatty on their 10:1 Super-charged Pratt & Whitney Wasp Engine during their record-making flight 'round-the-world. At the end of the flight, 108½ flying hours, the plugs showed a maximum gap of twenty-seven thousandths of an inch. . . . . The plugs functioned perfectly throughout the entire flight. Post and Gatty covered approximately 15,000 miles at an average speed of more than 138 miles per hour, and flew through temperatures ranging from hot to cold, and through weather changing from fair to misty and from heavy rains to pea-soup fogs. . . . . Short and long wave radio reception within range of their instruments was possible at all times without interference.

MAE 'Round the World



CORPORATION

NEW YORK, N. Y.

Contractors to the United States Army and Navy

"SPEED-FILTERING"

MEANS ALL IMPURITIES REMOVED AT 26 G.P.M.*

★ GALLONS PER MINUTE

G & B Filter Funnel—*modern high-speed filtering device, regular use of which "should add 200 hours to the life of a motor," according to aviation expert.*

LESS FIRE AND FIELD HAZARDS WITH THE G & B AEROPIT

Sooner or later it had to come—this fueling service purposely planned and built to fit airport needs! Airports are not street corners, nor do ships have the navigability of automobiles. That's why the G & B Aeropit takes gas out to the flying line. That's why, too, it lies flush with the ground so planes can run over it without danger. The Aeropit provides one-man fueling service—where such service is wanted—available 24 hours of the day. To both airport and operator it offers the maximum of convenience with the minimum of risk. Write for details.

This battery of 3 Aeropits at Le Bourget, France.

A few of many Aeropit-equipped airports:

Abilene, Tex.; Boston, Mass.; Cleveland, O.; Newark, N. J.; Kansas City, Kans.; Salt Lake City, Utah; Washington, D. C.; and Croyden, England.

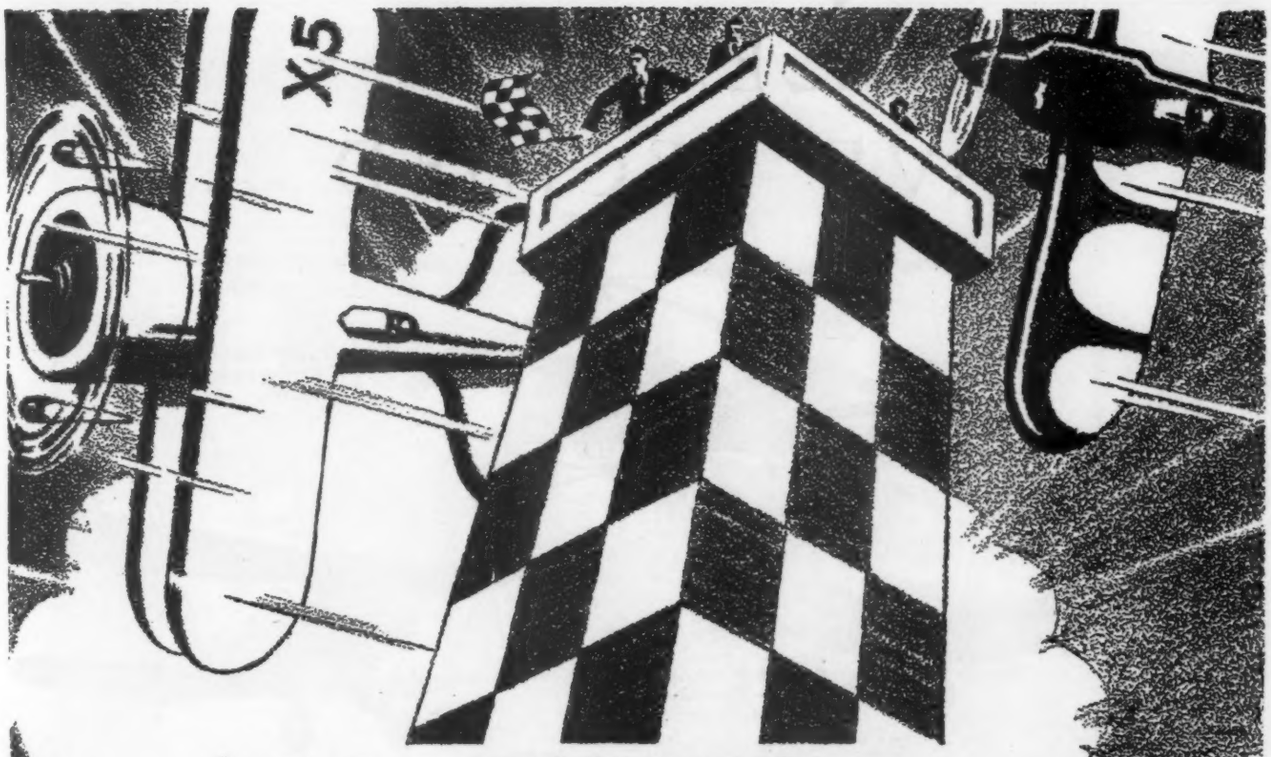
● When you fill up your gas tank, you're really buying *power with safety*—uniform power which will wing you through space without a sputter from your motor. Unfortunately, as every airman knows, impurities find their way into fuel.

● We built our Filter Funnel to make sure you get water-free, dirt-free gas—*full-power gas*—at all times. Here's the efficient filter you've waited for, combining thoroughness with speed. By actual test the Filter Funnel has proved 23-gallons-a-minute faster than chamois doing the same job. Takes out water, as well as sand, lint and sediment, at 26 gallons per minute. It's a protection you can't afford to be without.

● The Filter Funnel represents the best ideas of leading commercial transport operators. Flaring, reinforced legs. Handy shut-off valve. Discharge tube capped when not in use. Full details on request.

GILBERT AND BARKER
MANUFACTURING COMPANY
SPRINGFIELD MASS., U. S. A.
GASOLINE AND OIL FUELING EQUIPMENT

TRADE MARK G&B



ALL WINGS *toward* CLEVELAND!

NATIONAL AIR RACES

AUG. 29 *to* SEPT. 7

THE National Air Races are the nation's most outstanding sporting event. Not a dazzling dress parade, but a proving grounds for the industry's products. Each year they introduce new developments and improvements that strengthen aviation's position in the field of commercial transportation, and each year they contribute more and more to its growth and progress.

This year new pinnacles of achievement are expected to be reached in the scheduled speed classics. Cash prizes totaling $100,000 plus valuable trophies will be contested for. Transcontinental and On-To Derbies, straightaway speed dashes, free-for-all speed events, in addition to blimp, autogiro and amphibian novelty races, glider flights, parachute jumping contests, aerobatics and other innovations, inclusive of nightly flying exhibitions, will all contribute to the establishment of new standards of stability, safety, endurance, speed and serviceability, towards the end of eradicating the layman's notion of the hazards of flying.

A hearty welcome is extended you to be present as well as participate in this eleventh annual air classic. Complete details on request. Write Clifford W. Henderson, *Managing Director.*

NATIONAL AIR RACES

Hotel Cleveland, *Executive Offices*

CLEVELAND ✦ ✦ ✦ ✦ OHIO

LEADERS HAVE DECIDED . . .

● *Kellett Aircraft Company — Continental powered Autogiro*

● *Emsco Aircraft Corporation—Continental powered B-7-C Midwing Sport Plane*

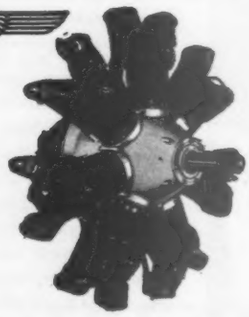
● *Waco Aircraft Company — Continental powered Model F2 Sport Trainer*

● *Verville Aircraft Company — Continental powered Sport Trainer*

● *Stearman Aircraft Company — Continental powered Model 6F Trainer*

● *Waco Aircraft Company — Continental powered Model C Cabin Plane*

Universal acceptance of the Continental A-70 — 165 h. p. aircraft engine has made it the leader in its field. More Continental engines are being installed by manufacturers as standard equipment in this power range than any other engine made. » BECAUSE— It is the lightest aircraft engine on the market. » Its comparatively small over-all dimensions permit a wide range of installations. » Army, Navy, and manufacturer tests have demonstrated its ability to stand up under rough treatment and hard commercial usage. » It carries the reputation and undivided responsibility of the famous Red Seal of Continental.

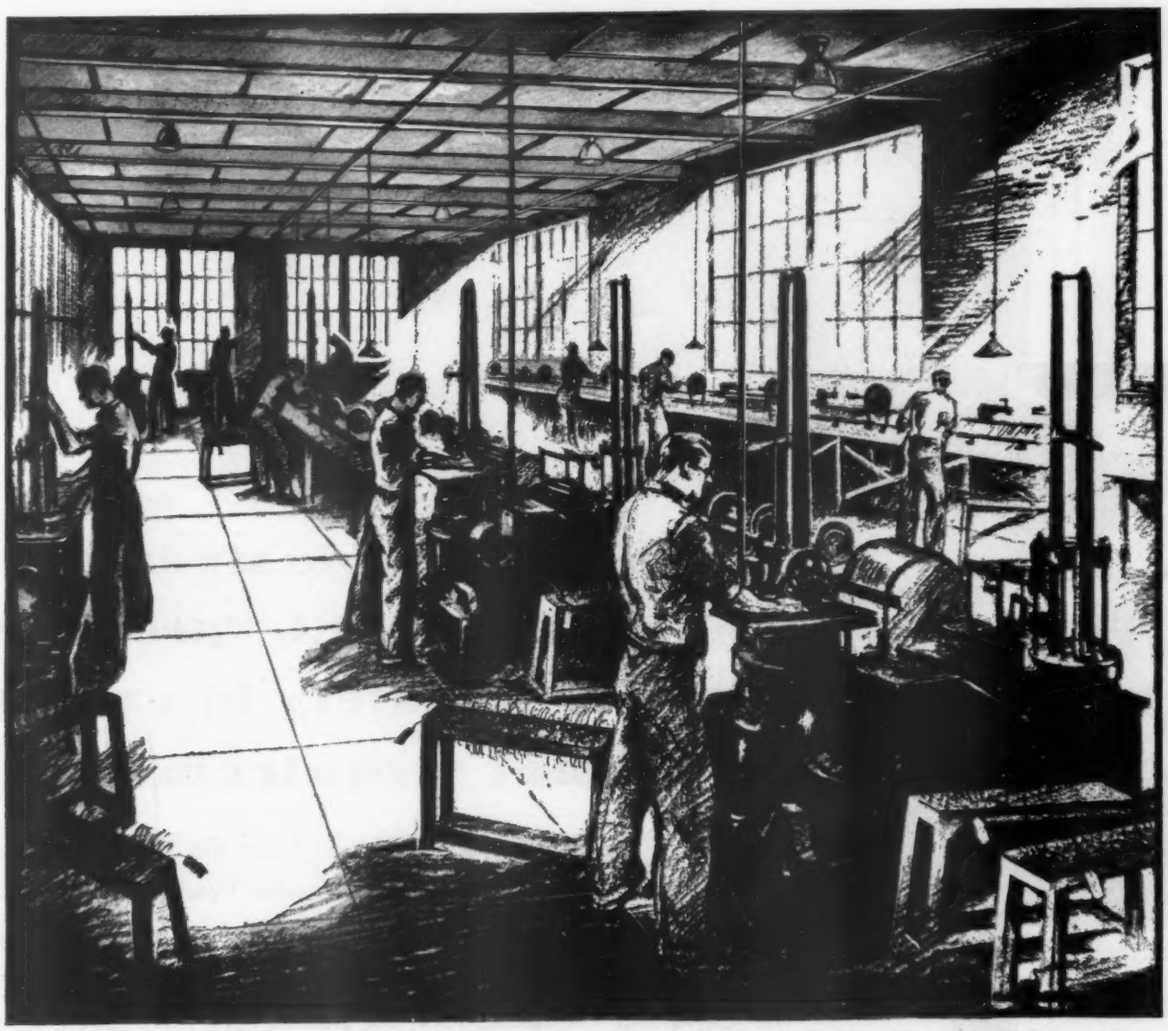


» » »

Continental A-70 Second Series
7 cylinder Radial Engine.
165 h. p. at 2000 r. p. m.

CONTINENTAL AIRCRAFT ENGINE COMPANY
General Office and Factory, Detroit, Michigan

Continental Engines



No. 10 of a series of advertisements on "How Superlative Quality is Built into Roebling Wire Aircraft Products"

Nothing is left to Chance

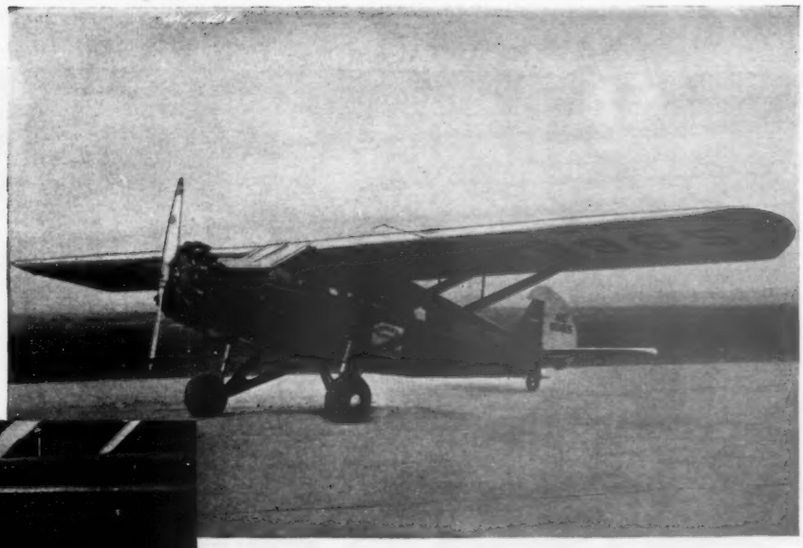
NOT even a single wire in a reel or coil of any Roebling Wire Aircraft Product is an "unknown quantity." Even years after shipment, its complete manufacturing history is retained in the Roebling files. At any time, Roebling can trace right back to the very heat of steel from which the wire was made.

In the testing laboratories, a typical view of which is shown above, *every* bundle of wire is painstakingly tested. Gauging, tension, torsion and elongation tests are made on samples of wire clipped from each bundle. No wire which does not meet the exacting Roebling standards is used for Roebling Aircraft Wire, Strand and Cord. For example, when testing the wire, only that which attains the very highest rating is accepted.

When you order a reel or coil of Roebling you get more than merely so many feet of wire, strand or cord. You get predetermined quality, known stamina, safety —of the highest degree.

JOHN A. ROEBLING'S SONS COMPANY
WIRE . . . WIRE ROPE . . . WELDING WIRE . . . FLAT WIRE
COPPER *and* INSULATED WIRES AND CABLES
WIRE CLOTH *and* WIRE NETTING . . . *Export Dept., New York*
TRENTON, N. J. *Branches in Principal Cities*

ROEBLING WIRE AIRCRAFT PRODUCTS



Dependable materials are the best assurance of dependable performance

Upper view shows the Travel-air plane of the CLEVELAND PNEUMATIC TOOL CO., equipped with Aerol struts, which are standard equipment on this and other leading makes of aircraft. Middle view shows close-up of Aerol struts on landing gear.

The "*remarkable strength*" of NICKEL STEEL "provides a factor of safety in excess of actual requirements"

● Think of the terrific stresses placed upon the small-sectioned parts of pneumatic landing struts! Consider how strong and dependable these parts must be to assure safety and comfort in landing, taking-off, and taxi-ing over rough ground.

The Cleveland Pneumatic Tool Co. states: "We have been using 3½% Nickel Steel in the cylinders and pistons of our Aerol struts since they were first designed in 1926 by our chief engineer, Mr. John F. Wallace. The remarkable strength of this steel provides a factor of safety in excess of actual requirements, and there has never been a failure of one of these struts."

Since Nickel Alloy Steel has demonstrated beyond question its toughness and dependability for so many aircraft engine parts, it is only natural that it should be used in Aerol landing struts. May our engineers assist you in selecting Nickel Alloy Steels for your special requirements?

THE INTERNATIONAL NICKEL COMPANY, INC.

Miners, refiners and rollers of Nickel... Sole producers of Monel Metal

67 Wall Street, New York, N. Y.

Nickel
ALLOY STEEL
PERFORMS BETTER LONGER

THE MARK OF NICKEL

Send for our booklet, "The Curtiss and Wright Engines and their Use of Nickel Alloy Steel"

An open throttle eats up oil . . . . . *use* PENNZOIL *costs less per hour*

Ask for PENNZOIL—
Not just "Pennsylvania Oil"

Aviation engines operate under heavy loads all the time. The simplest precaution to avoid trouble is to use Pennzoil Aircraft Oil. High speeds and high temperatures won't wear it out. It improves performance. It increases motor life. It reduces overhaul and repair expense.

In addition, Pennzoil is economical to use. It lasts twice as long as ordinary oils. It costs less per hour. The next time you buy oil, say "Pennzoil."

The PENNZOIL COMPANY: Executive Offices and Refinery: Oil City, Pa.
Division Offices: New York, Chicago, Los Angeles
British-American Oil Co., Ltd., Sole Distributors in Ontario and Quebec, Canada

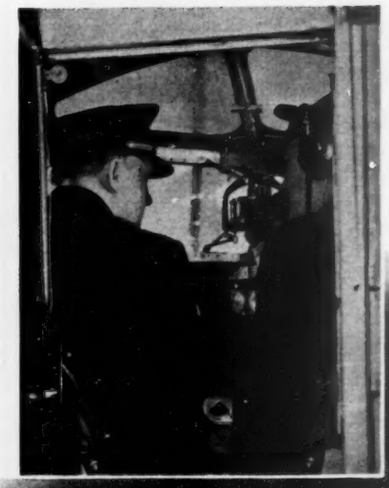
100% PURE PENNSYLVANIA
PENNZOIL
SAFE LUBRICATION

PENNZOIL is made by the famous Pennzoil Process from 100% pure Pennsylvania crude and nothing else.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N.

When FOG
Blankets the "Hell Stretch"

dependable Exides keep pilots on the course, via Radiophone



Winging through the fog. Depending on radio for guidance. The pilot who has Exides aboard is safeguarded. He knows what weather to expect ahead. The condition of landing fields.

Exide Aircraft Battery—a battery made to fly. Light-weight —compact—safe.

Dense fog. Flying blind. Only radio to tell him whether he is on the course and of weather conditions ahead.

Exide Aircraft Batteries help make radio *certain*—and do other jobs just as dependably. They furnish current for landing, avigation and instrument lights—starting and ignition. Exides have proved their worth over millions of miles of sky lanes. They are so designed that the electrolyte will not spill—even in the hardest kind of flying service. This is but one of many reasons why they are preferred.

Ask your flying friends about Exide reliability. Or write today for further information about the many types of Exide Aircraft Batteries. One-seater "mono" or cabin plane—there's an Exide to fill the bill.

Exide
AIRCRAFT
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto

CHECK

the Value Point for Point

and you will find no plane in the class and price of the Great Lakes Sport Trainer.

A. C. E. Cirrus 4 cylinder-in-line, air cooled upright engine, 90 h. p. at 2,100 r. p. m. (Also available with inverted engine at slightly increased price.)

High speed, 110 miles per hour.

Cruising speed, 90 miles per hour at 1,825 r. p. m.

Endurance at cruising speed, 4.10 hours.

Range at cruising speed, 370 miles.

Fuselage, welded chrome molybdenum steel tubing, Warren truss bracing.

Wings, now built with 3° dihedral in upper wing and 2° dihedral in lower wing for augmented stability. Total wing area, 187.6 sq. ft.

Weights, gross 1580 lbs., empty 1016 lbs., useful load 564 lbs.

And a score of other outstanding advantages that you should know about.

$2985

FLYAWAY FACTORY

1931 NATIONAL AIR RACES CLEVELAND AUG. 29 — SEPT. 7

ACCLAMATION

YOU HEAR IT wherever you go—wherever air minded folks get together. The talk of the year is the New Great Lakes Sport Trainer. "What a wonderful ship it is—and the price is only $2985."

For here is a practical, proven training and sport plane—of even greater stability—that is as beautiful to behold as it is to fly. Enlarged tail surfaces, improved wing spread, and symmetrical cowling for greater visibility.

Built as every Great Lakes ship must be built—with the fervor of genuine craftsmanship. Inspected to military standards. Engineered according to the highest aeronautical principles.

Of course you want to know about the Great Lakes Sport Trainer, just as eagerly as we want to tell you. Write today and let us give you the over-all story of this master training ship.

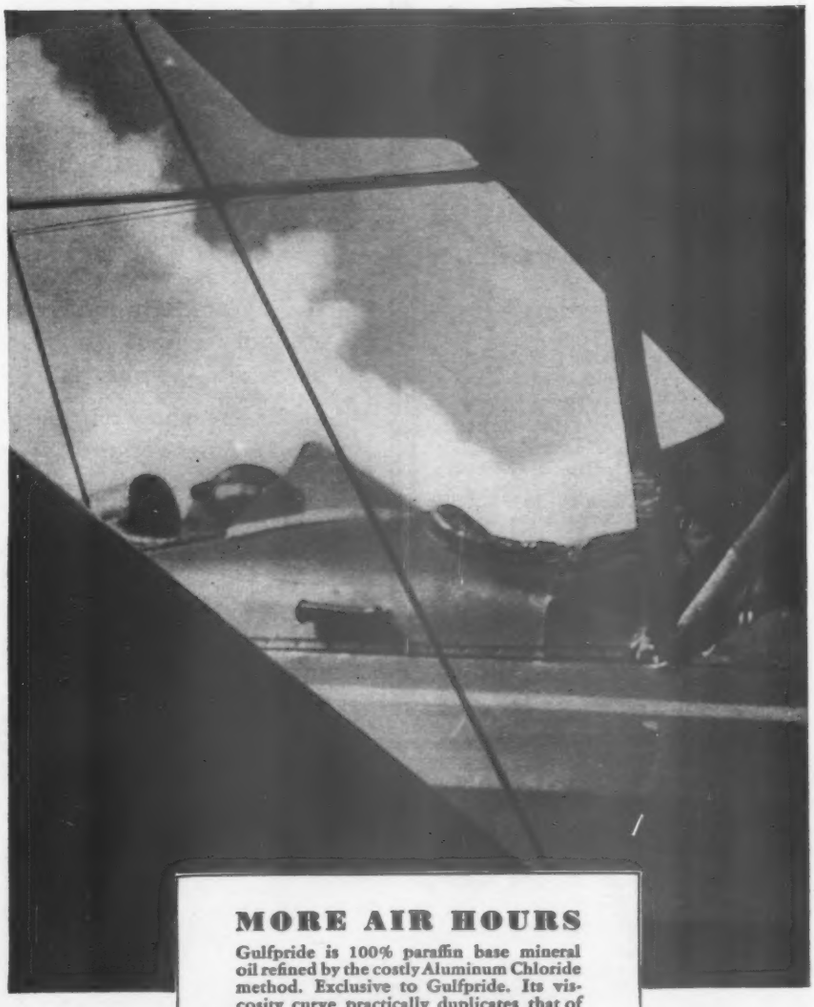
GREAT LAKES CORPORATION
Contractors to the United States

GLAC

AIRCRAFT CLEVELAND
Army and Navy

GREAT LAKES SPORT TRAINER

No sir... oils are *not* "all alike"



... if you think they are, just read these quick facts!

Gulfpride is refined with aluminum chloride, costing $100 per ton. Contrast this with the $10-per-ton acid commonly used.

Gulfpride 120 shows a carbon residue (Conradson test) of 2/10ths of 1% ... that's 84% *less carbon* than the next best oil that has ever been offered for aeroplane use.

Gulfpride 120 increases R. P. M's. You can prove this by any fair test you want to make. The difference is big enough for any experienced pilot to see.

Once you try it, we feel sure you'll ask for Gulfpride 120 every time you tell a ground crew to "oil her up".

RECORDS? You'll find them listed in the Gulfpride Aviation Atlas. New edition ready soon. Free to licensed pilots and to students of recognized flying schools. Price to others 50¢. If you want a copy just write to Gulf Refining Co., Lubricating Dept., General Sales Offices, Pittsburgh, Pa., U. S. A.

MORE AIR HOURS

Gulfpride is 100% paraffin base mineral oil refined by the costly Aluminum Chloride method. Exclusive to Gulfpride. Its viscosity curve practically duplicates that of highest grade castor oils. Yet Gulfpride has none of castor's gum forming tendency.

Gulfpride holds its body at high temperatures and resists breaking down under motor heat. It is highly resistant to oxidation and emulsifying action.

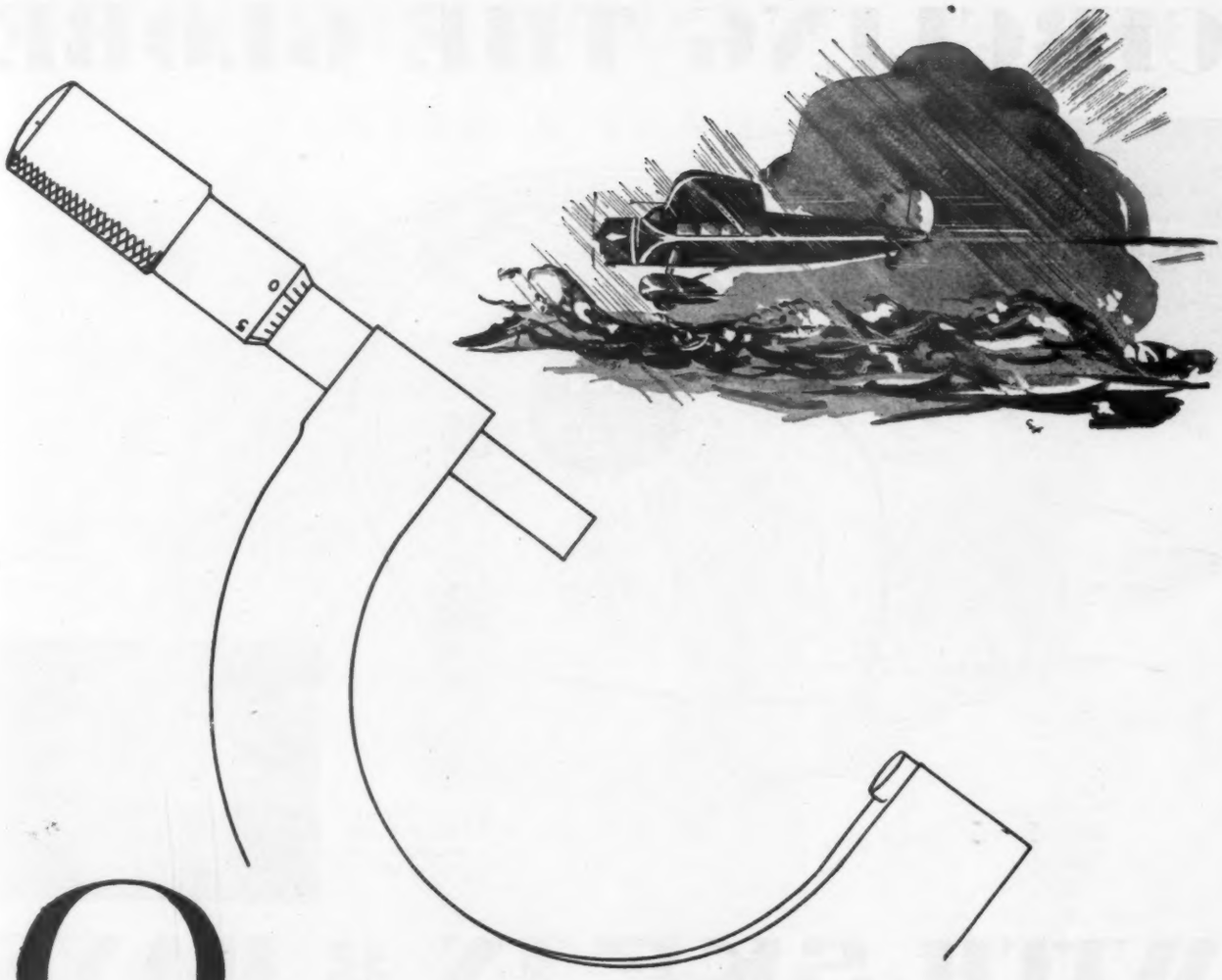
Gulfpride is made in five viscosities; 75-100-120-150 and 200 at 210°F, providing a superior lubricant for all types of aircraft motors, under all operating conditions.

Ask for Gulfpride 120 and you'll never be grounded because of oil-caused trouble.

GULF

Gulfpride Oil

• GULF REFINING COMPANY •



ONE PLACE *where nothing but the* BEST *will do*

IT IS written indelibly into Aviation precepts that only the best of engineering talent may design engines and engine parts, and likewise, that only those shops whose experience, equipment and code have given them a standard of exacting accuracy to produce these parts.

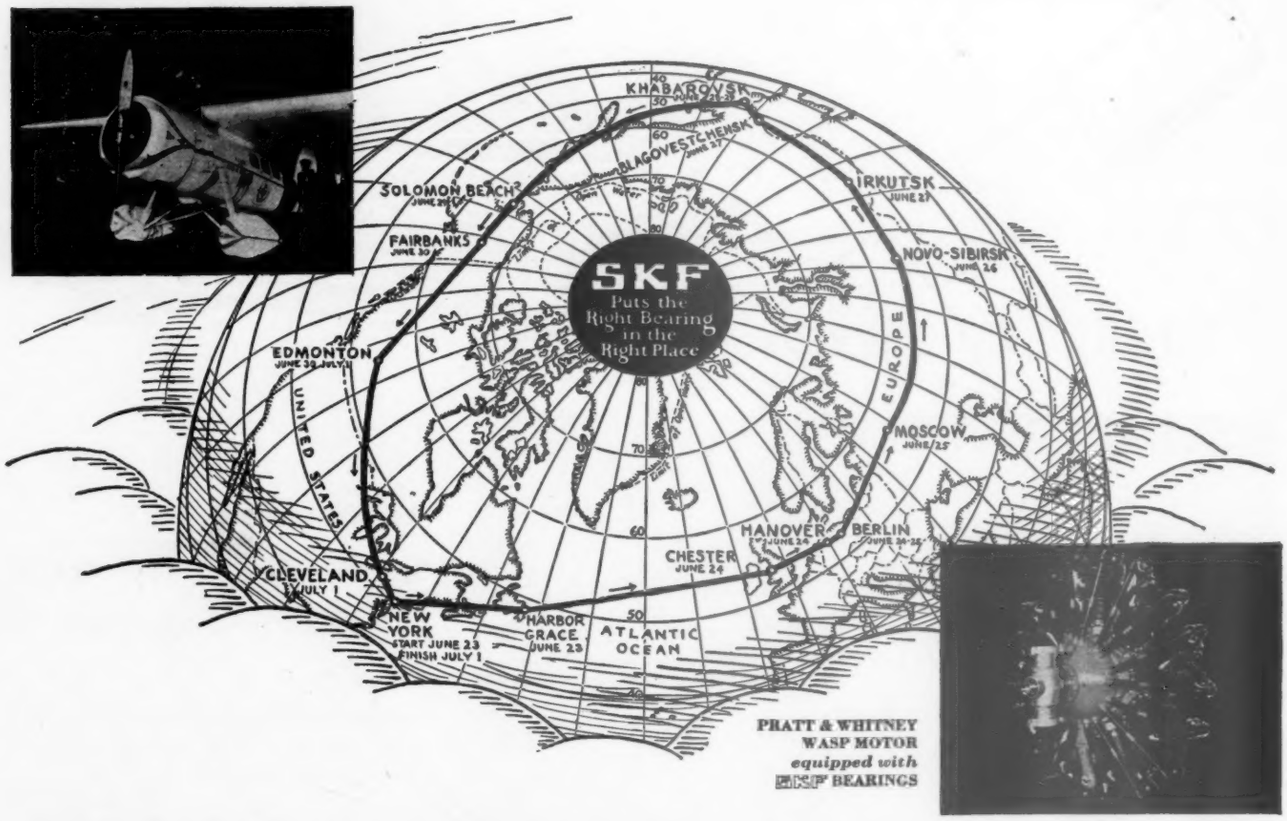
The shops of Govro-Nelson were among the first in America to signify complete understanding of these demands by the installation of production machines that work with almost human care, testing equipment that checks and re-checks with an accuracy of .0001" and a personnel that is both wise in experience and young in vision. (The experimental and production facilities of Govro-Nelson are used increasingly by aircraft engine manufacturers who are honestly striving for correctness of design and dependability while in flight.

THE GOVRO-NELSON COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

CIRCLING THE GLOBE



PRATT & WHITNEY WASP MOTOR *equipped with* SKF BEARINGS

WITH SKF IN 8 DAYS

AROUND the world in eight days...one-tenth the time Jules Verne visioned! This lopping off of time through the modern miracle of aviation is a far cry from the trip Magellan, a brave navigator made over 400 years ago, circumnavigating the globe in 1083 days. Riding with the Lockheed Vega on its epoch-making flight were SKF Bearings...a grueling test of men and equipment. Through millions of revolutions, SKF's never faltered but proved, once again, that SKF Performance takes Preference Over Price in the air.

Fifty-nine SKF Bearings are used in Pratt & Whitney Wasp commercial engines of the type on the "Winnie Mae." The same smooth operation, ruggedness and stamina, the feeling of security and dependability which SKF Bearings bring to famous flights is known by leading manufacturers in the world's outstanding industries. Where quality and *known performance* are the standard of acceptance, there can be no substitute for SKF Bearings.

SKF INDUSTRIES, Inc., 40 E. 34th St., New York, N.Y.

2719

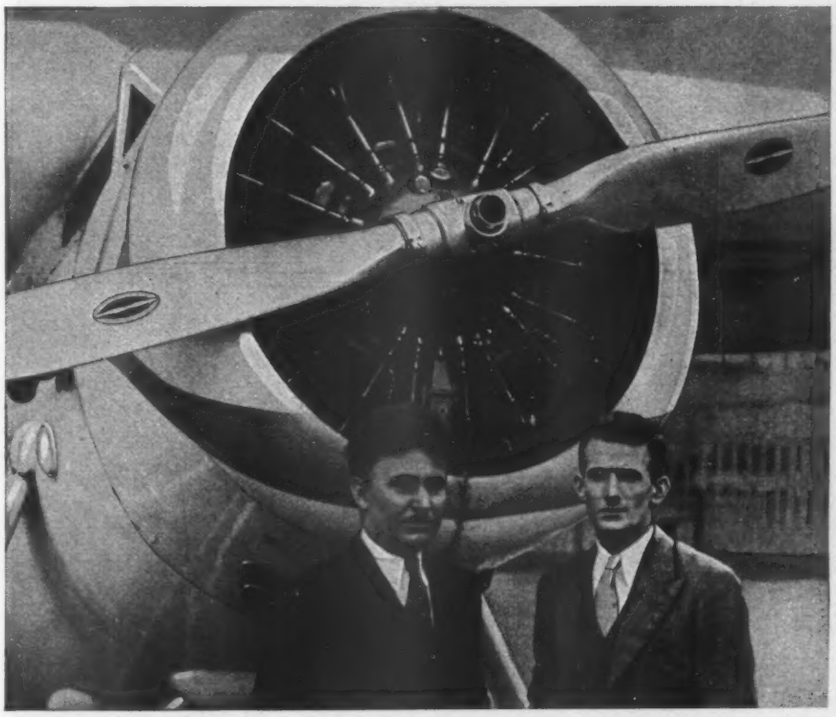
SKF

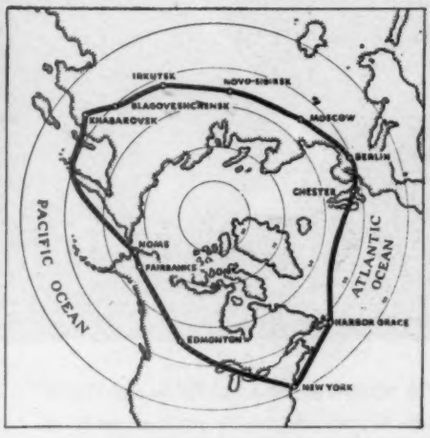
BALL AND ROLLER BEARINGS

ROUND THE WORLD IN 8½ DAYS

WITH A YEAR-OLD

★WASP ENGINE★





Wiley Post and Harold Gatty with their record-smashing, Wasp-powered Lockheed. The map shows their route, which took them over two oceans, across seven countries and through temperatures varying from torrid to arctic. The total flying time for the distance of 15,474 miles was 4 days, 10 hours, 8 minutes.

To Wiley Post and Harold Gatty who flew their Lockheed plane around the world in 8 days, 15 hours and 50 minutes, the builders of their Wasp engine extend heartiest congratulations. The engine used was a standard supercharged Wasp, a year old, which had had approximately 300 hours of use in Mr. F. C. Hall's private Lockheed. This same engine, flown at full throttle for 9 hours, won the Los Angeles-Chicago non-stop derby of the 1930 National Air Races at an average speed of 192 m.p.h. Prior to the world flight the engine was overhauled by the Aero Corporation of California.

Checked after its grueling flight of 15,474 miles, the Wasp was pronounced by Post to be ready, without any replacement, for another trip around the world. Just one more demonstration of the kind of Pratt & Whitney stamina which accounts for the use of Wasp & Hornet engines by the Army, the Navy and on most of the important, regularly scheduled air transport lines of this country.

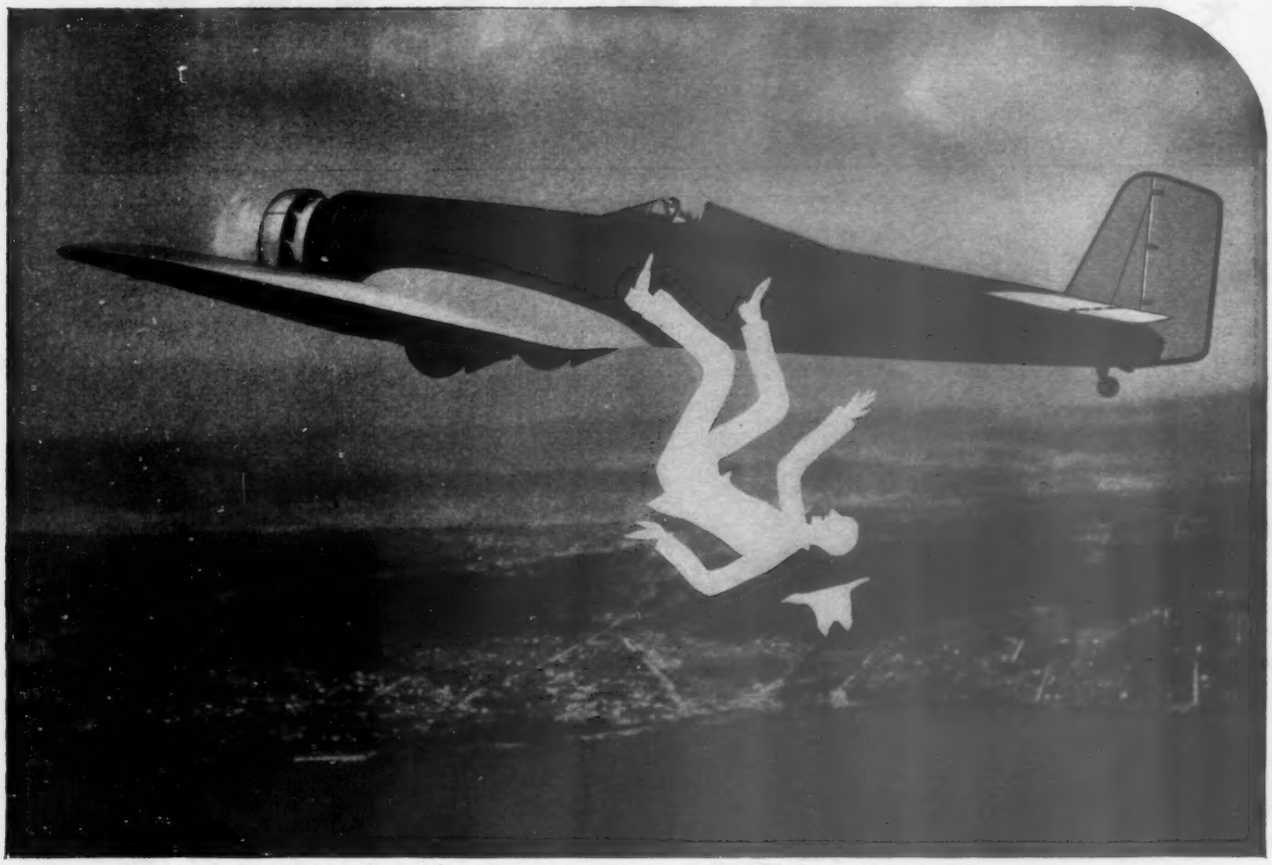
Wasp* & Hornet* *Engines*

* Registered Trade-Mark

THE
PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . . CONNECTICUT
Division of United Aircraft & Transport Corp.

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo.

SO LONG AND BAD LANDING, MR. WATER-THIN, YOU HAD NO BUSINESS COMING UP!



NO BUSINESS IN A PLANE is right! For Mr. Water-thin is the quart or more of thin, waste oil that ordinary refining leaves in every gallon of motor oil. Stuff that can't lubricate—stuff that vaporizes quickly under motor heat — skyrockets oil costs.

But Quaker State Aero Oil contains none of this "water-thin." Quaker State removes it with the *most modern refining in the industry*. And Quaker State replaces it with rich, full-bodied lubricant. So you get four full quarts of lubricant to the gallon of Quaker State—not three quarts and one of waste. You really get an extra quart of lubricant. You get an oil so good that it has become *the world's largest selling pure Pennsylvania Oil!*

There's another reason why Quaker State is good for far more hours in the air—why it lubricates not only longer, but better. Every drop of Quaker State is made from 100% pure Pennsylvania Grade Crude Oil. It is so free from impurities that it does not require acid treatment in refining. That's important! For acids tend to destroy some of an oil's oiliness.

Give Quaker State a test in your planes. You'll find that it saves money all along the line. Saves money in oil. Saves money in maintenance. You'll find that the extra quart of lubrication makes it by long odds the greatest oil that ever went into a plane!

QUAKER STATE
TRADE-MARKS REG. U.S. PAT. OFF.
MOTOR OIL

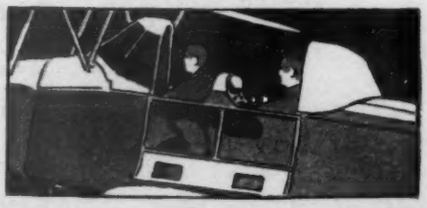
THERE'S AN EXTRA QUART OF LUBRICATION IN EVERY GALLON

OPEN COCKPIT AND CABIN-TRAINED —*in the Same Plane*

Under Department of Commerce regulations, commercial schools are required to give students solo training in both open cockpit and cabin planes. To the fortunate school operator whose field is equipped with The FLEET, this provision no longer necessitates an investment in two types of planes. For now The FLEET is convertible. Its roomy open cockpit can be quickly changed to an equally roomy cabin by means of the new FLEET cabin enclosure, illustrated at the right... Opening lengthwise along the top center, the walls of The FLEET cabin enclosure fold down on either side of the fuselage, from which position they can be quickly detached. Of solid, sturdy construction, light in weight, with vibrationless and anti-rattle features, The FLEET convertible cabin enclosure gives you two planes in one ● The student will do well to enroll for training in a FLEET equipped school, thus learning to fly the plane he eventually will buy... The majority of independent schools are equipped with FLEETS.

LIST OF SCHOOLS

Aero Corporation of California
Air Express, Inc.
Air Services, Inc.
Air Tech. Flying Services, Ltd.
California Aerial Transport
Central American Aviation Corp.
Cleveland Institute of Aviation
Dallas Aviation School and Air College
DW Flying Service
Furniture Capital Air Service, Inc.
Garland Aircraft Corp.
Hancock Foundation College of Aeronautics
Kearney Flying Service, Inc.
Lenox Bros. Flying School
Luddington Flying Service, Inc.
Mamer Flying Service
Michigan Aero Club
Midwest Airways, Inc.
National Airways, Inc.
Palwaukee Airport, Inc.
Penn School of Aviation
Pocahontas Air Transport
Roosevelt Field, Inc.
San Diego Air Services Corporation
Standard Flying School
Wedell Williams Air Service
Westchester Airports Corp.
Yellow Cab Airways



THE FLEET

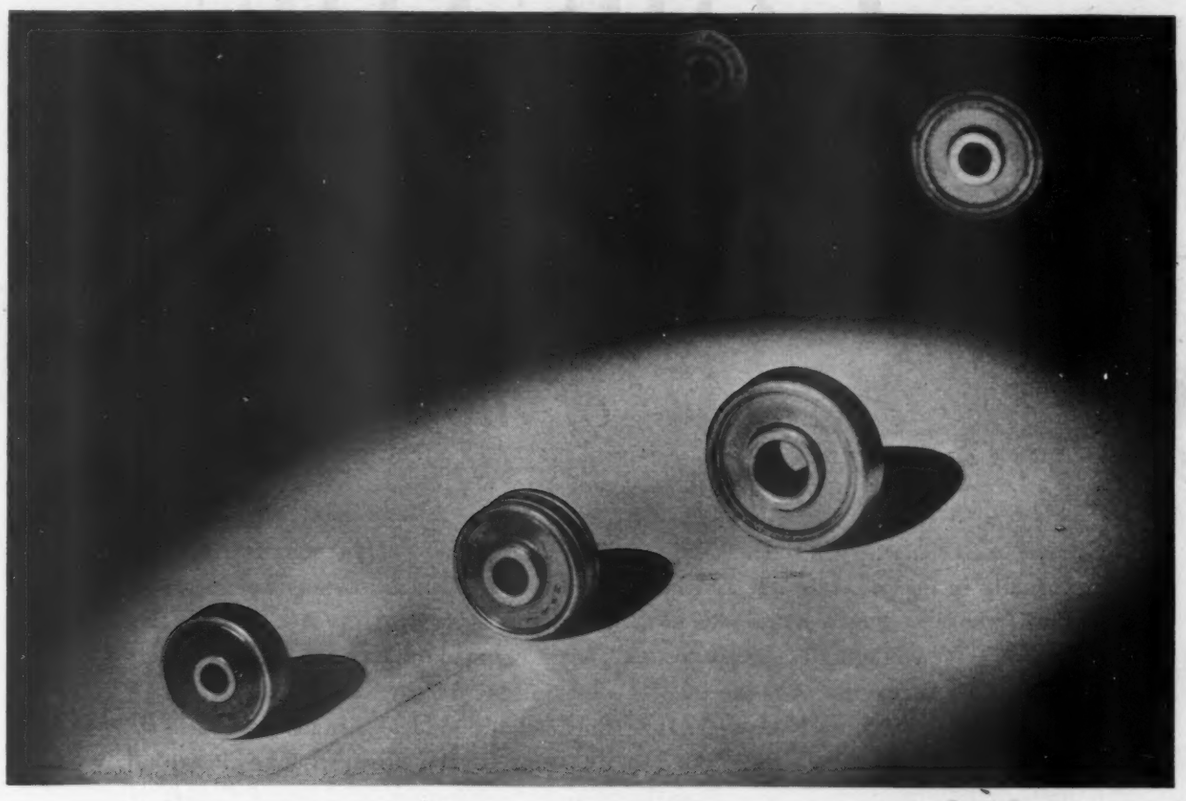
FLEET AIRCRAFT INC. • BUFFALO, NEW YORK

Junior Speedmail 300 and 400 H. P.
. . . . . Business Speedster 240 H. P.
. . . . . Cloudboy 165 H. P.

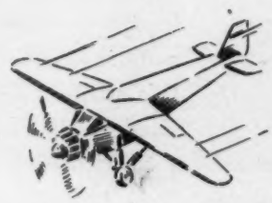
Pay loads pay in a STEARMAN

MAIL operators, especially, have favored Stearman . . . for many reasons . . . the ship itself, an outstanding piece of aircraft engineering . . . the Stearman organization with its understanding of the operator's needs . . . the nation-wide service facilities backed by United. American Airways, flying 20% of the air-mail mileage in the United States, for instance, are receiving delivery of twelve Stearman Senior Speedmails, illustrated.

STEARMAN AIRCRAFT COMPANY, WICHITA, KANSAS, *Division of United Aircraft and Transport Corp.*
United Aircraft Exports, Incorporated, 230 Park Avenue, New York, Exclusive export representatives



Fafnir Simplifies
Aviation's bearing problems



IN a completely anti-friction bearing-equipped control system, there is an almost innumerable variety of ball bearing applications. Ordinarily this would mean many bearing types, many designs, most of them departing widely from standard. But not so with Fafnirs.

Fafnir's close cooperation with aircraft builders has resulted in the development of a few basic bearing types that meet all needs. One such type is the Fafnir Double Seal Ball Bearing which is used extensively for Control Pulleys. But it is also adaptable to bell cranks, control surface hinges, and the like. This versatility of application provides economy through standardization, and an always available standard stock.

Other designs which Fafnir engineers have developed in conjunction with aircraft engineers and designers, include ball bearing cartridge, torque tube bearings, and an inch dimension series, all described in the Fafnir Aircraft Data Sheets. Write for copies.

THE FAFNIR BEARING COMPANY, NEW BRITAIN, CONNECTICUT

Atlanta Chicago Cincinnati Cleveland Dallas Detroit Los Angeles Milwaukee Newark New York Philadelphia

FAFNIR
BALL BEARINGS

CORSAIRS

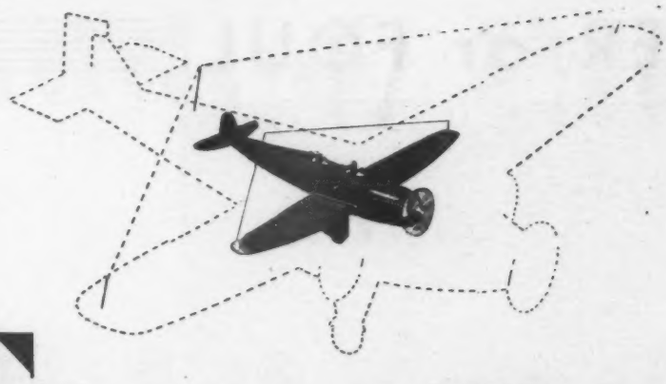
that wear the GLOBE AND ANCHOR *of the U. S. Marines*

Corsairs in service with the Marine Corps are usually in *active* service. It may be in Haiti, whose ragged, mountainous interior affords few landing fields that are even possible. It may be over the inaccessible jungles of Central America. It may be in China in sections where plane failure would write "Finis" to an aerial mission.

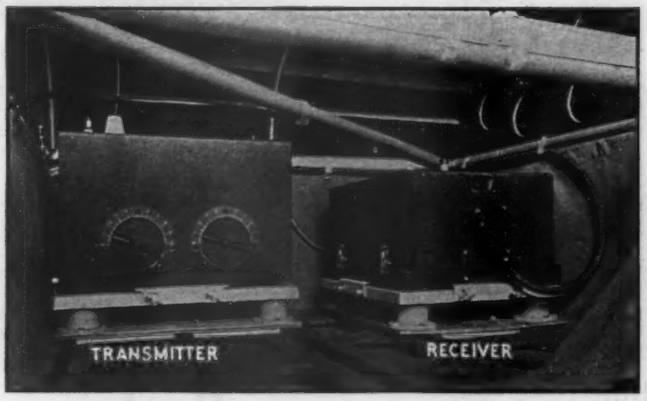
Corsairs ask no odds of the men who make their assignments, or the men who do the flying. The stamina to stand rough landings and the performance to get into and out of small fields are traditional with this plane. So, too, are its speed—its climb and its excellent handling qualities.

These distinctly Vought characteristics have carried *Corsairs* through years of strenuous service with the Marine Corps. They have made the *Corsair* a standard observation plane with the Navy. And they make it an ideal ship for fast executive transport and private flying. Chance Vought Corporation. Division of United Aircraft & Transport Corporation, East Hartford, Connecticut. Export representative: United Aircraft Exports, Inc., 230 Park Avenue, New York, N. Y.

CHANCE VOUGHT CORPORATION



The *small* plane too can now have its Western Electric Radio



. . . . *little brother* of the radio that flies more than 2,700,000 miles each month in transport operation

These newest members of the Western Electric radio telephone family—receiver and transmitter—are ideal for the short line and private plane. Compact, tipping the scales at only 17 and 18 pounds respectively, the 9D receiver and 11A transmitter are readily installed in any plane. With them you hear Department of Commerce weather broadcasts and beacon signals—you talk with radio equipped airports—you fly with transport efficiency! Write for details to Western Electric Company, Dept. 259 A, 195 Broadway, New York.

Western Electric*

Aviation Communication Systems

MADE BY THE MAKERS OF BELL TELEPHONES

**Northern Electric in Canada*

Western Electric radio has proved its reliability through millions of miles of flying in every kind of weather. It is standard on the following transport lines:

AMERICAN AIRWAYS
- Colonial Division
- Universal Division
- Southern Division
- Embry-Riddle Division

UNITED AIRLINES, INC.
- Boeing Air Transport
- Pacific Air Transport
- Varney Air Lines
- National Air Transport

TRANSCONTINENTAL & WESTERN AIR

WESTERN AIR EXPRESS

NATIONAL PARKS AIRWAYS

NORTHWEST AIRWAYS

FAIR WEATHER or FOUL

. . . all the same to SOCONY

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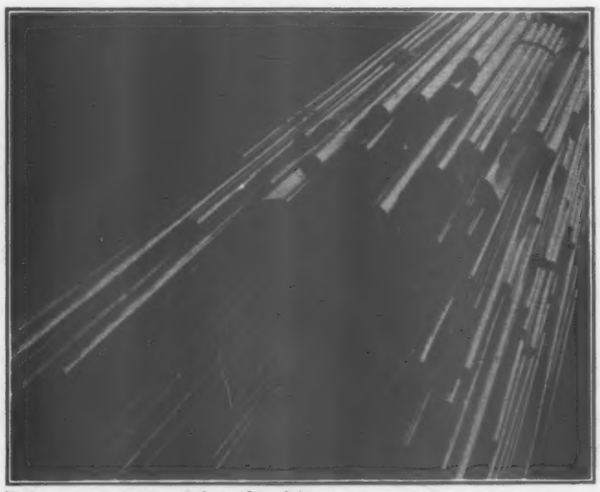

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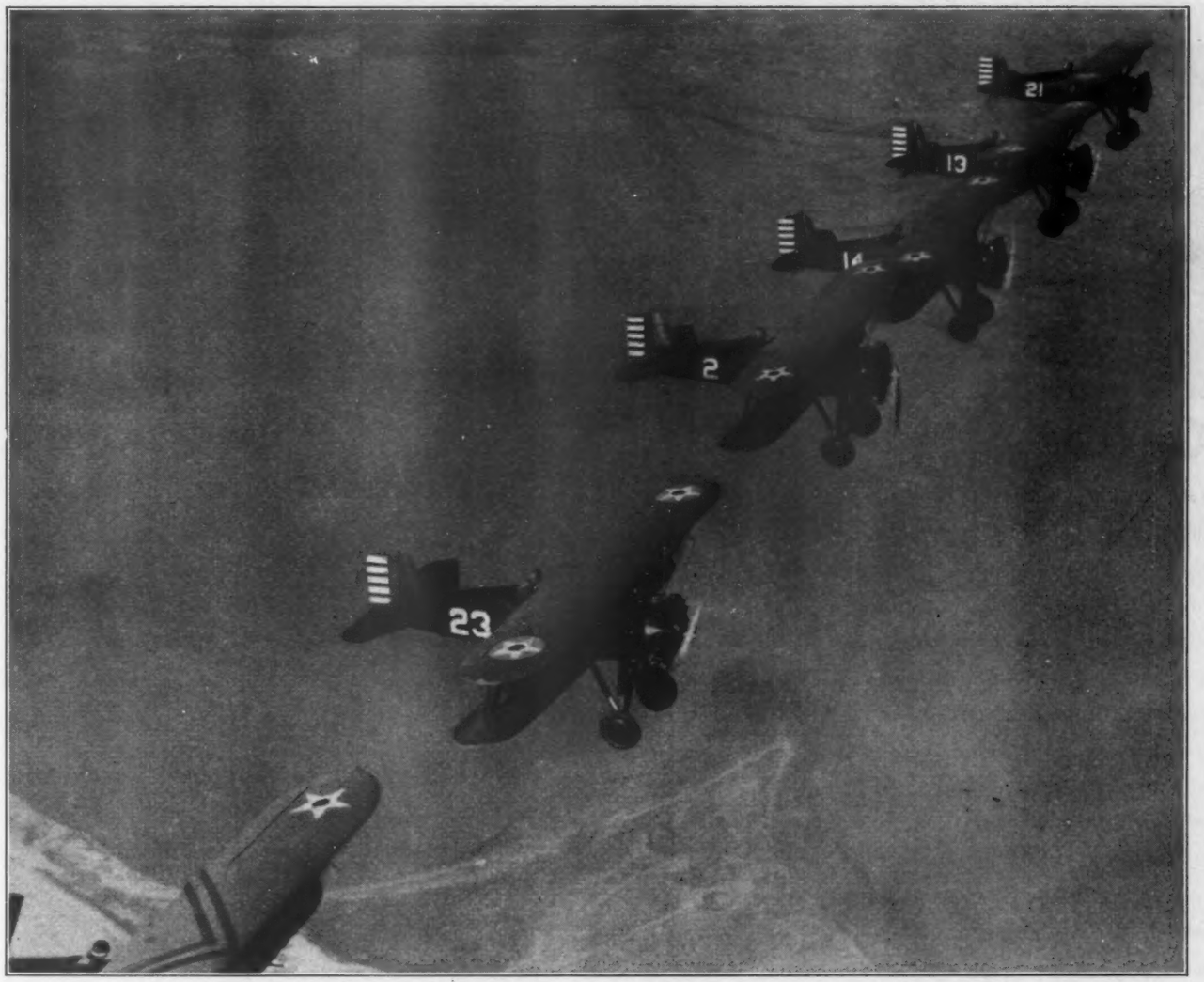

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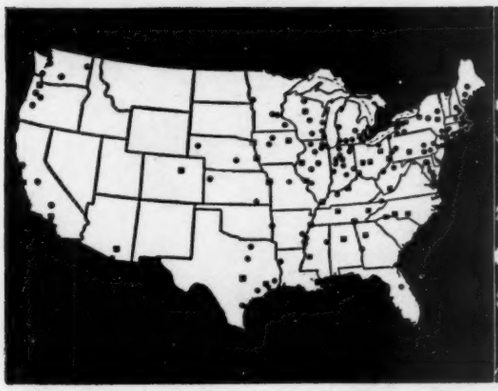

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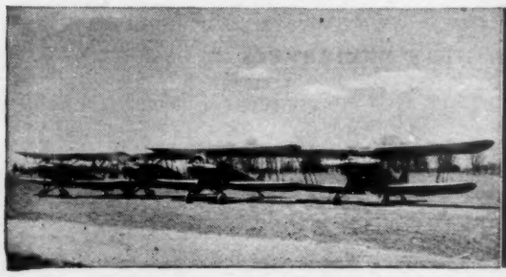

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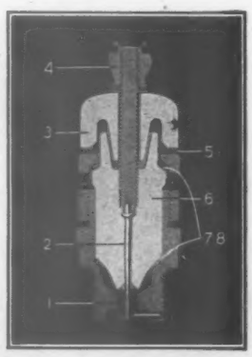

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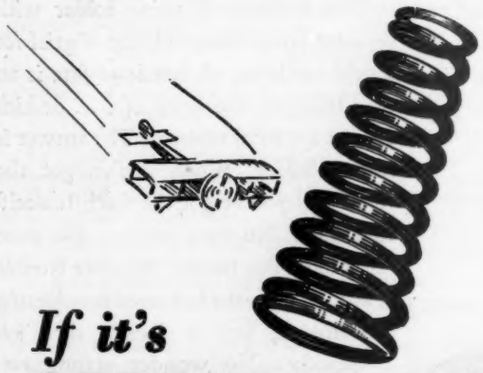

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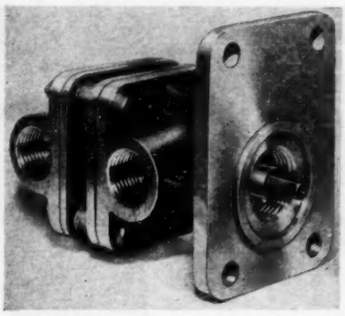

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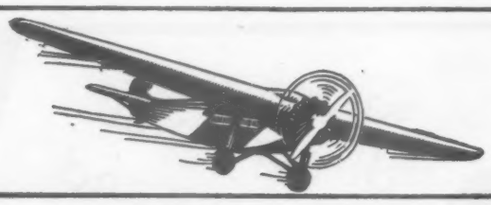

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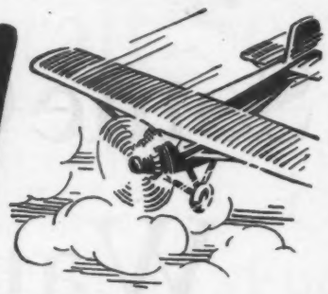

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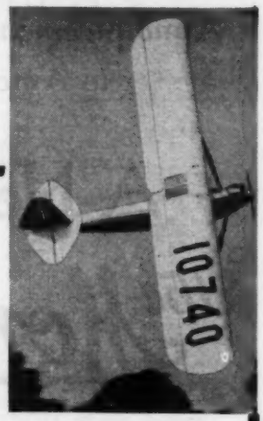

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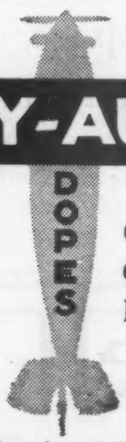

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AFTER August 1, 1931, the Monocoupe will be manufactured at Lambert Field, Robertson (St. Louis), Missouri.

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We have purchased the Lambert Aircraft Engine Company and will operate this company as the Lambert Engine & Machine Company, Moline, Illinois. All Lambert engine service will be handled in Moline. All service on airplanes will be handled at Robertson, Missouri.

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Successors to

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GN-034

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and airplane construction, repairing, servicing and sales distribution.

—the foregoing summarizes the products and services offered, this issue.

Some items pertinent to aircraft building and operation are of small unit price, limited application or subject to other restrictions that do not economically justify prominent advertising. They are accordingly offered for your consideration through the card advertisements on this page. The extent to which you are thereby served—not the size of the cards—is the measure of value to you.

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The following pages

will interest you. The "Where To Fly" page has interesting announcements of fields and instruction. The "Searchlight" pages summarize current business opportunities in the field of aviation. It's a good habit to check them, each issue.

Professional Services

If you cannot find the kind of professional service you need on this page, write at once to the Professional Directory Division, Tenth Ave. at 36th St., New York City. You will be put in prompt touch with reliable individuals or firms offering the services required.

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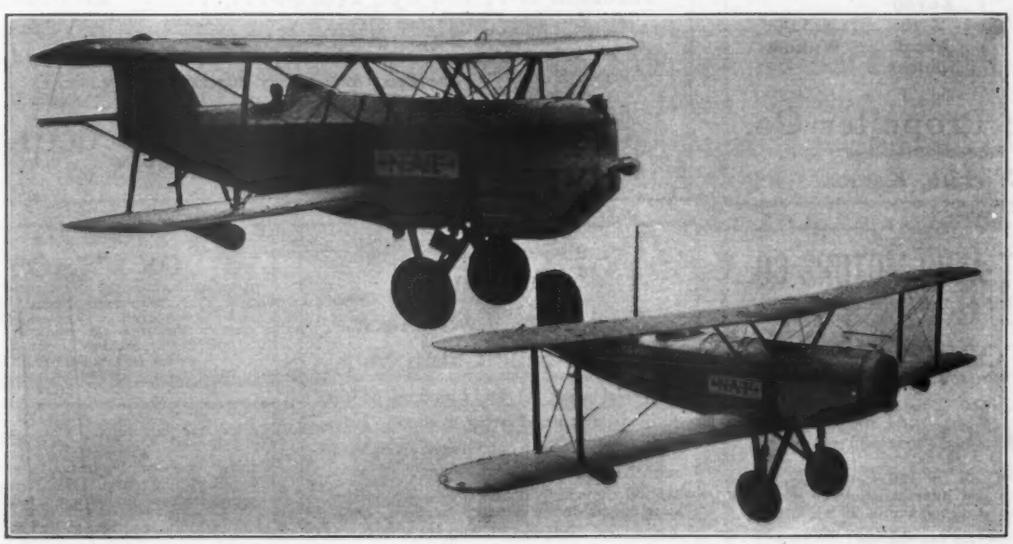

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Engine	Liberty	Liberty
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Cruising Speed	115 MPH	110 MPH
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Capacity	54.4 CU. FT.	60.6 CU. FT.
Main Gas Tank	120 Gal.	120 Gal.
Gravity Tank	15 Gal.	10 Gal.
Gas Consumption	25 Gal. per hr.	25 Gal. per hr.
Oil Tank	12 Gal.	12 Gal.
Rate of Climb	480 FPM	500 FPM
Wing Span	38 FT.	45 FT. 8 IN.

Dept. of Com. License Nos.

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NC-112-E	NC-255-H	NC-8670	NC-1063	C-791
NC-208-E	NC-256-H	NC-1645	NC-795	C-793
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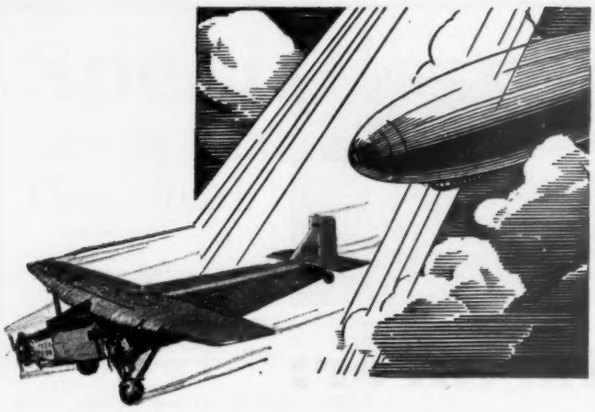

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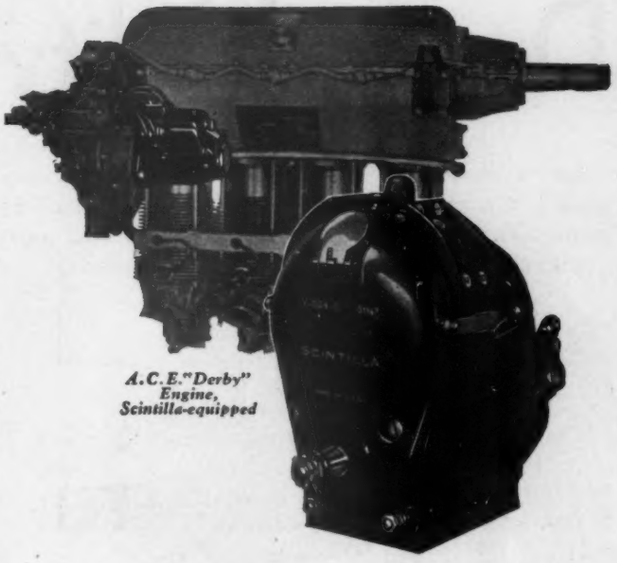

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ACCESSIBILITY

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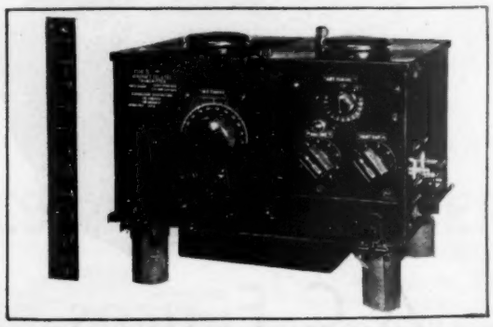
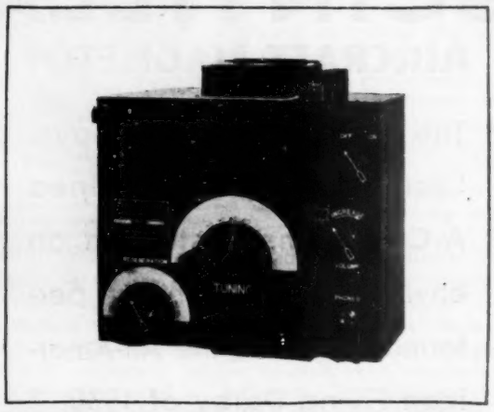


Type B Radiophone and telegraph transmitter for mounting anywhere in the ship to operate on any wave length between 30 and 900 meters. Weight 16 lbs., 6 ozs. Price $1,000 f.o.b., New York.



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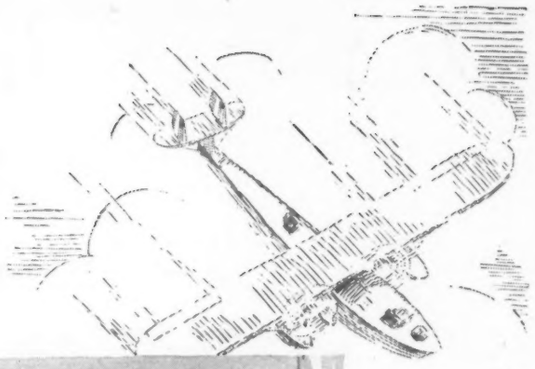
AVIATION
August 1931

VICTORY
in the Battle Against CORROSION

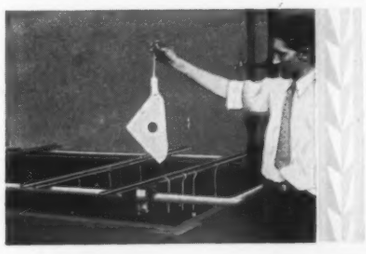


Anti-corrosion processes, developed by Martin, conquer destructive action of salt air and sea.

ACCURATELY controlled heat treating of aluminum alloys. Anodizing to coat the metal with a smooth, protective film which slightly absorbs and thus firmly holds bituminous paint. Spraying or rubbing *each separate part* with bituminous paint immediately after anodizing. Spraying with further special finishes after assembly. Covering with pure aluminum foil all parts in contact with wing fabric.

These are some of the anti-corrosion processes which are standard practice in the Martin plant. And these processes help explain why Martin all-metal planes are so thoroughly corrosion-proof, so economical to maintain.

Nowhere else in the industry will you find such highly developed anti-corrosion processes, and such extensive equipment for their use, as in the Martin plant. Nowhere else in the industry can aircraft of equal quality be produced in quantity at lower cost.



Above: "Not a sign of corrosion was found." That is what Naval inspectors reported after carefully inspecting Martin Seaplanes which had been in Southern waters with the Fleet for two years.

Left: The anodic film is deposited on all treated surfaces, protecting the inside of long tubes, and the corners, crevices and edges of irregularly shaped parts.

Above: To prevent corrosion at points where parts are joined, each individual part is given a separate coat of bituminous paint immediately after anodizing and before assembly.

Left: Special anti-corrosion finishes are applied after assembly. The large tunnel-type spray booths will accommodate even a completely assembled 100-foot hull.

✣

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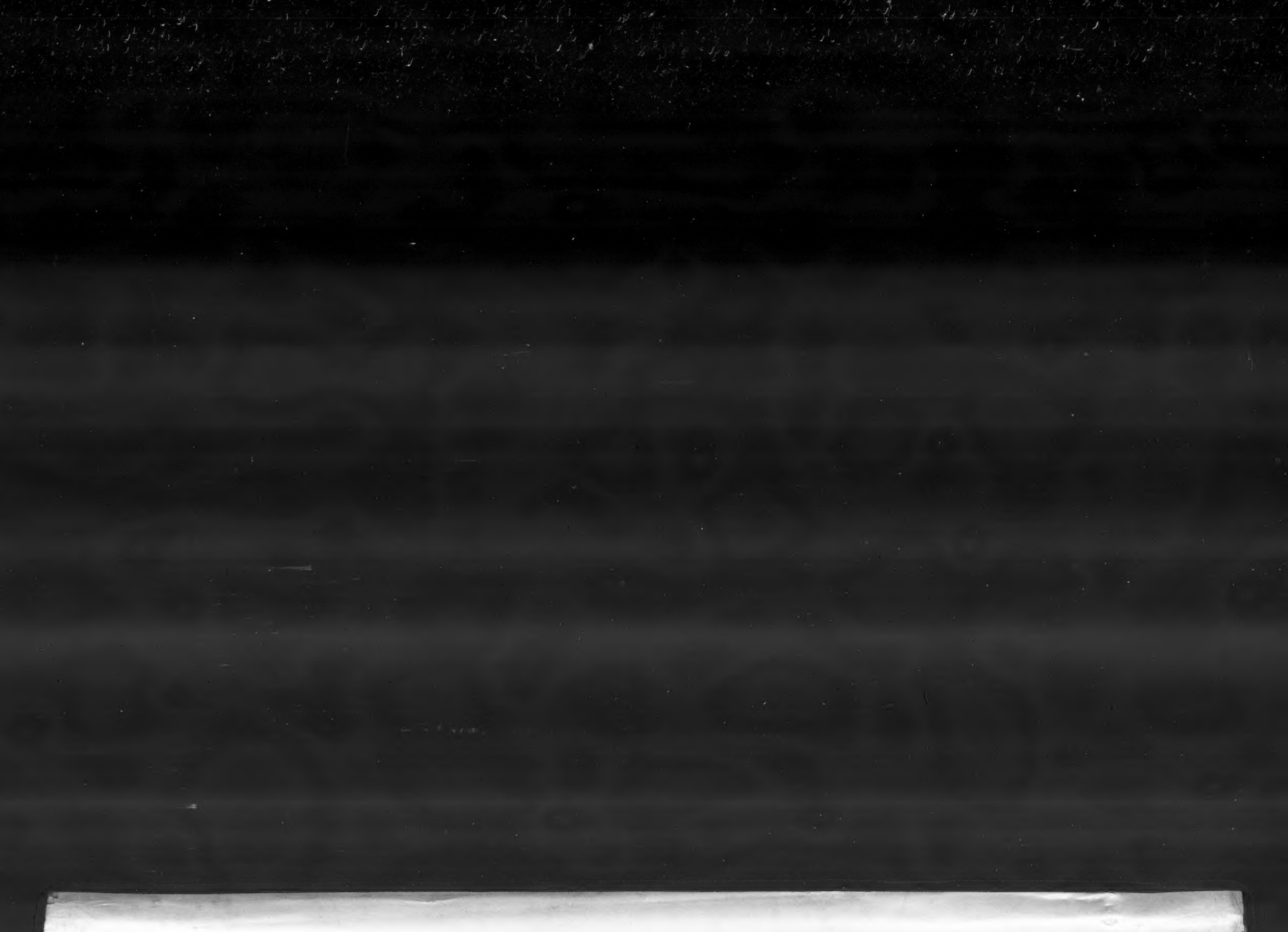
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